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The Problem of Pattern Storage

During a Press visit to the works of a London foundry, we inspected a pattern for making what will be the largest crankshaft this concern has so far cast. It is a one-off job and is for delivery abroad. The pattern is the property of the customer and the situation demands its storage for at least a reasonable period. This will involve the more or less permanent use of 50 cubic feet of space in the pattern stores. It is, moreover, typical of what is happening daily throughout the industry. Many hundreds of patternshops are daily turning out large quantities of patterns, whilst but relatively few are being destroyed. This is creating a situation reminiscent of the Augean stable, but for the Herculean task of cleansing the nation's pattern stores, there is no convenient river to be diverted from its course.

There are a number of methods employed for the orderly storage of patterns. By orderly we mean economical utilisation of space; easy identification and convenience in general handling. Some firms deem it logical to keep all the patterns and core-boxes for the Jones's concern in one location. This we deem in most cases to be unsatisfactory, as the mixing of large and small components in the same bin, rack or area results in wastage of space. It is preferable to store patterns by type, disregarding their origin. It will probably be a nuisance if, as is not uncommon, the Jones's company asks for the return of all its patterns. Yet for economy in space, storage according to the nature of pattern still seems desirable, for the conservation of space in most cases is a major problem. Two obvious methods of saving space are the rapid return of patterns to the customer where repeat orders are not obvious, and the ruthless scrapping of the obsolete. In the case of standard patterns for merchant trade, where the customer insists that his name appears, then the use of loose letters or nameplates to be attached to the pattern will effect economy in material and storage. There are too many patterns for municipal work and the like of precisely the same type, but carrying permanently the name of the customer.

From an article which we recently published on the precautions to be taken against the risk of fire in pattern stores, it would seem that an orderly well-filled shop, free from draughts, is distinctly safer than its opposite. This article is well worth study. Whilst on this question of patterns, it is interesting to note that a standardised colouring method is in very general use in the Metropolitan area, but in the East Midlands we understand that no real headway has been made. This may be due—we do not know—to the local master patternmakers using their own traditional markings. If they would but adhere to the specified markings, the shops attached to the foundries would quickly and continuously emulate their lead. Easter time is traditionally associated with spring cleaning and there is no better place to start than the pattern stores; nor could the time be more opportune. We remember Mr. R. Greenwood telling us, when he was a director of Combustion Engineering Company, that he cleared out over a thousand patterns and had to re-make but a handful. Are founders quite sure that something of the sort could not be done with their accumulation of patterns to ease the existing pressure on space?

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Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

To the Editor of THE FOUNDRY TRADE JOURNAL

RELATIVE COSTS OF CORE BINDERS

SIR,—I have been most interested to read, in the March 24 issue of your Journal, the abridged version of the very useful Paper by Mr. W. W. Braidwood, entitled "A Decade of Progress in British Ironfounding." There is one point in connection with core-bonding agents on which I feel some comment is required. Mr. Braidwood states that:—"Recently, successful use of synthetic resins has been reported. It is doubtful, however, if these, even when produced on a large scale and at correspondingly lower cost, can compete successfully with seed oils at normal prices."

I am not sure what the author means by "normal prices" for seed oils. If he is referring to the price in the region of £20 per ton, which I understand obtained during the 1930's, then I concede that synthetic-resin core binders may have difficulty in competing on a simple price basis. Even then, however, there would be many cases where the particular advantages offered by the synthetic-resin binders, *e.g.*, greatly reduced baking time and improved collapsibility at casting temperature, would alter the overall economic balance in favour of the resins and against linseed or similar seed oil.

Present-day prices of seed oils are very many times higher. Linseed oil to-day costs about twice as much as a synthetic-resin binder of equivalent bonding strength. Since there seems to be little likelihood of any steep drop in seed-oil prices, within the next few years at least, the economic advantages seem likely to remain strongly in favour of the synthetic-resin binders.

While the object here is to draw attention to the cost factor, I do not minimise the technical problems that have still to be solved before synthetic resins can replace seed-oil binders to a major extent. These problems are, however, being investigated energetically by a number of foundries and by synthetic-resin manufacturers, with results which are considered most encouraging for the future of synthetic resins in the foundry industry.

Yours etc.,
P. G. PENTZ.

Leicester, Lovell & Company, Limited,
North Baddesley,
Southampton.
April 7, 1949.

MR. E. BURGESS, proprietor of the Darra Foundry, Darra, Brisbane, Queensland, Australia, is having a six-months' holiday in this country. His foundry employs about 10 moulders and coremakers and services the local cement works, brickworks, tramways, and the municipality. Mr. Burgess served his apprenticeship at the old British Westinghouse and at George Richards & Sons, Limited. This is his first visit after spending 27 years in Brisbane. His address during his stay in this country is Brookside, Abbs Cross Lane, Hornchurch, Essex.

Forthcoming Events

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

APRIL 20.
Institution of Production Engineers

Edinburgh Section :—"Electronics in Industry," by P. H. Briggs, B.Sc., at the North British Station Hotel, Edinburgh, at 7.30 p.m.

Liverpool Section :—Annual General Meeting and Presidential Address at the Exchange Hotel, Liverpool, at 7.15 p.m.

APRIL 21, 22 and 23.
Institute of British Foundrymen.

Training Course for Foremen at Ashorne Hill, Leamington Spa. (Programme published in the JOURNAL, January 20, page 46.)

APRIL 22.
Institute of Metals.

Birmingham Local Section :—"Corrosion," by W. H. J. Vernon, O.B.E., Ph.D., D.Sc. Joint meeting with the local section of the Royal Institute of Chemistry, at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 6.30 p.m.

Institution of Mechanical Engineers

"Invention and the Sifting Out of Engineering Facts"—James Clayton Lecture, by E. G. Bailey, D.Eng., D.Sc., Hon. M.I.Mech.E., at Storey's Gate, St. James's Park, London, S.W.1, at 6 p.m.

APRIL 23.
Leeds Association of Engineers.

Visit to the Works of Hopkinsons, Limited, Britannia Works, Huddersfield. Details from the Secretary.

West of Scotland Iron & Steel Institute

The following office-bearers were elected at the annual general meeting of the West of Scotland Iron & Steel Institute in Glasgow on April 8:—As *President*, Mr. W. Barr, who succeeds Mr. T. M. Service; as *vice-president*, Mr. H. Harris; as *hon. treasurer*, Mr. P. W. Thomas; as *councillors*, Mr. P. T. Carter, Mr. J. M. Ferguson, Mr. R. M. Howatt, Mr. W. M. Service, and Mr. J. H. Tennent.

It was reported that because of increased costs the accounts for the session 1947-48 showed a deficit of £122. The Council thereupon moved an alteration of rules to provide for an increase of subscription to 30s. for ordinary members and 15s. for associate members.

Following the business meeting, a paper entitled "Scrap Preparation and Furnace Charging as Related to Cold-metal Open-hearth Shops," by Mr. W. A. Johnson, research and development department, United Steel Companies, Limited, Rotherham, was presented.

THE BRANCH WORKS OF INTERNATIONAL COMBUSTION LIMITED at Port Elizabeth, South Africa, is installing a completely mechanical foundry.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, Trafford Park, Manchester, 17, have sent us this year's "Pretty Girl" calendar, for which we tender thanks.

MR. CHARLES E. LAY, foundry director of John Jones & Sons, Limited, iron and brass founders, engineers, etc., of Britannia Foundry, Meadow Lane, Loughborough, Leicestershire, sailed from Southampton on April 1 for America, where he plans to make a six-weeks' tour of ironfoundries.

The Engineering Properties of Meehanite*

High-duty Castings from the User's Viewpoint

By A. Campion, Hon.M.I.B.F

Introduction

The Author proposes to outline the extent of the progress made in regard to the characteristic properties of high-duty material with special reference to its consistent dependability as an engineering material. There have been many different processes tried in an endeavour to manufacture an improved cast iron at various times. They have all, consciously or unconsciously, attempted to control the graphitisation and to produce a close-grained, dense iron. Some have aimed at the retention of the identity of what is commonly understood as "grey cast iron," together with an economic advantage over steel castings.

The early processes devised for the production of cast iron having superior strength characteristics all suffered from the lack of a method of precise control of the size, form and distribution of the graphite within a wholly pearlitic matrix. This absence of control led to inconsistency of the strength values, thus preventing any guarantee that the castings would be to a predetermined specification.

Early History

In 1924 Meehan experimented in the manufacture of grey cast iron of superior strength and physical properties, by the use of an agent to promote graphitisation from many nuclei. This type of iron was developed by Smalley and others, and as a result of many years' concentrated research it represents a serious advance in the metallurgy of cast iron.

The particular type of high-duty iron developed from the original idea of Meehan is known as Meehanite metal. It can be controlled to meet definite service requirements and possesses physical properties superior to ordinary cast iron or steel-mix iron. Methods used in its production permit of absolute control, which removes uncertainties and results in a material which can be relied upon, at all times, to give the service properties called for. Meehanite of itself is not specific, it covers the activities of a world-wide organisation, engaged in research and development of every phase in the production of castings to meet high performance service requirements in industry. This material is not just another cast iron, but is a group of high-duty irons; there are nearly thirty, each of which is manufactured, under a strict system of control, to possess certain properties and characteristics, which will make it suitable for meeting some specific service requirement. No one type of iron is suitable for each and every service condition.

*An abstract from a lecture given at the Engineering Centre, Glasgow, Sir John Duncanson presiding.

In general, service requirements place a casting in one of the following categories:—

1. *General Engineering*, involving strength, toughness, resistance to shock, damping capacity, machineability and pressure tightness.
2. *Heat Resistance*, involving retention of strength under continuous or intermittent high temperatures, resistance to scaling, or distortion, and non-growing tendency.
3. *Wear Resistance*, involving resistance to abrasion and erosion, impact, rolling or sliding friction, and freedom from galling or seizing under severe conditions.
4. *Corrosion Resistance*, involving ability to resist chemical attack, by acids or alkaline liquids or vapours.

The process used permits accurate control of the metal to definite specification to meet the service requirements. The metal in each ladle may be processed to meet a given set of conditions of mass influence, as it affects strength, hardness and machineability, so that uniform density and strength properties in castings of varying sections are assured.

Uniformity of Structure

The uniformity of the material in comparison with steel-mix cast iron poured into 12-in. cubes is illus- in Fig. 1(*a*) and 1(*b*), which show the Brinell hardness values obtained on sections through the centre of cubes. It will be observed that there is a considerable fall in the hardness from the outside to the centre of the grey-iron piece, whilst in the Meehanite piece, apart from the corners, the Brinell figures are uniform throughout the section.

The designer is interested in the influence of mass on

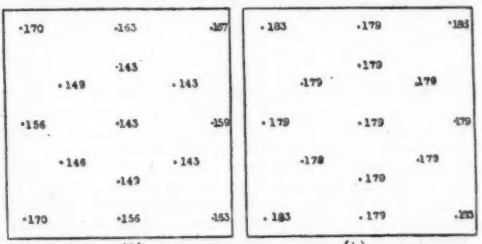


FIG. 1.—BRINELL HARDNESS VALUES ON SECTIONS THROUGH THE CENTRE OF CUBES: (*a*) STEEL-MIX CAST IRON; (*b*) MEEHANITE METAL.

The Engineering Properties of Meehanite

the strength of the material employed and wishes to know to what extent he can rely upon the load carrying capacity of the different sections in the casting.

Figs. 2 and 3 show a comparison between grey cast iron and high-tensile Meehanite. This is one of

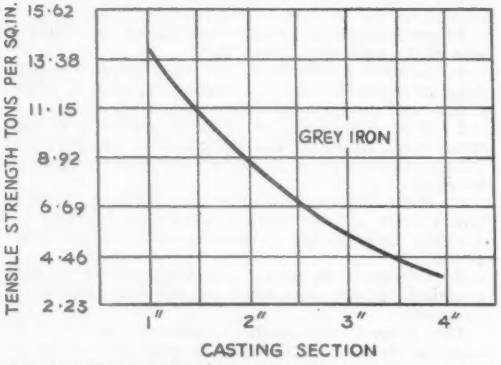


FIG. 2.—GRAPH SHOWING THE EFFECT OF MASS ON THE TENSILE STRENGTH OF GREY CAST IRON.

the outstanding features of the process and is the result of a long and carefully planned research.

Engineering Properties

Cast iron is usually classed as a weak, brittle and more or less unreliable material from a design point of view. It is considered to be lacking in elastic properties and has no straight-line relationship between stress and strain in tension, compression or torsion, except at stresses below 1,000 lb. per sq. in. However true this may be of ordinary grey iron, it does not apply in the case of modern high-duty iron.

The general engineering types provide a group of materials having tensile strengths ranging from 15 to 30 tons per sq. in. in the "as-cast" condition, and higher strengths may be obtained by special treatment.

The designer and the production engineer usually have the responsibility of specifying the material to be employed in the construction of their product. He has therefore to have some knowledge of the material he wishes to specify in order that he may make the most advantageous recommendation based upon:—(1) The basic engineering properties of the material in relation to the service demanded; (2) the selection of the proper material in relation to the casting sections, and to the mechanical properties demanded, and (3) the manner in which the specific properties of the material can be utilised to the best advantage in designing the castings.

The selection of the right material, so far as these products are concerned, has been considerably simplified by the fact that general engineering materials are manufactured in five main processes, each designated by symbols GA, GB, GC, GD and GE, the tensiles of which range from a minimum of 24 tons per sq. in. in GA to minimum 14 tons per sq. in. in GE.

There is a minimum thickness into which each of these processes may be poured and yet maintain its standard strength, hardness and free machinability. The GE and GD may be poured into sections below ¼ in.

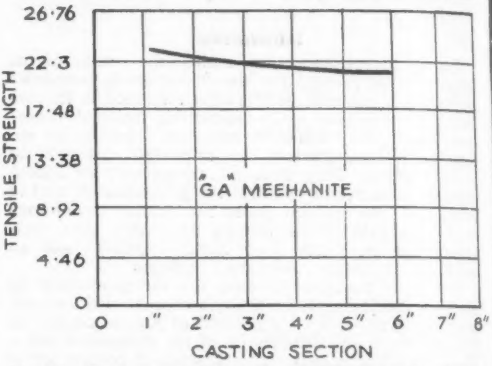


FIG. 3.—EFFECT OF MASS ON THE TENSILE STRENGTH OF MEEHANITE TYPE "G.A."

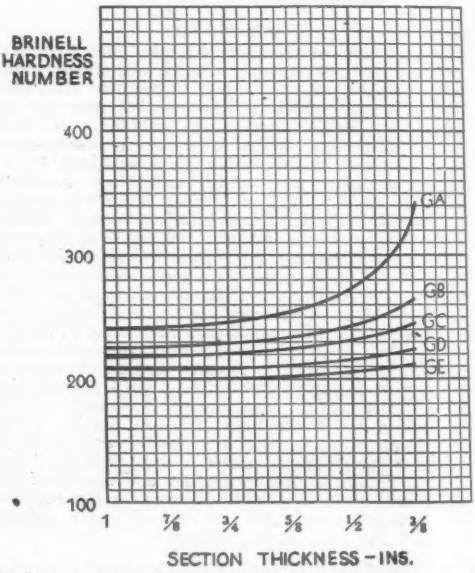


FIG. 4.—GRAPH SHOWING INCREASING HARDNESS WITH DECREASING METAL SECTION.

and still retain greyness and free machineability. There is, however, a border-line change between grey and white material, which gives rise to an improved structure that increases physical properties. This change is most pronounced in GD and GE, which are those best suited for thin sections.

The tensile strength of GA is about 24 tons per sq. in. when poured in 1-in. section and may show a small increase if poured into thinner sections, but in sections under ½ in. the strength it may fall and the metal may present machining difficulties. Type GC, which in 1-in. section gives 20 tons per sq. in., will show an increase in strength to 23 tons as the section is reduced to ½ in. Thus GC in ¾-in. section compares with GA in 1¼-in. or with GB in 1-in. section so far as tensile strength is concerned.

When specifying physical properties in light castings that are required to have easy machining qualities, the effect of sectional dimensions must be kept in mind, as is shown in Figs. 4 and 5.

It is generally realised that the ultimate breaking strength is not the criterion of load-carrying ability, upon which the engineer bases the design and dimensions of a member. He works upon the elastic properties and yield strength, that is, the stress the material can withstand without permanent deformation. The yield point is, therefore, a characteristic of direct interest in engineering design. In the case of cast iron there is a narrow range between yield stress and the ultimate breaking stress, whilst in most steels the gap between yield and the ultimate breaking load is considerable.

Table I shows the relation between the yield and tensile breaking strengths for the more generally used materials.

Reference has already been made to the fact that the old concept of cast iron as a brittle material, which showed no straight-line relationship between

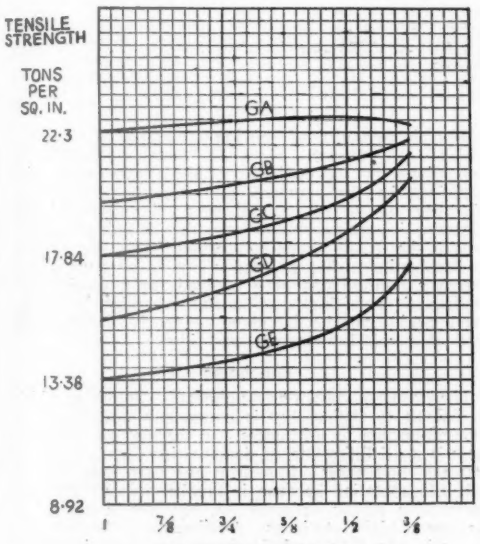
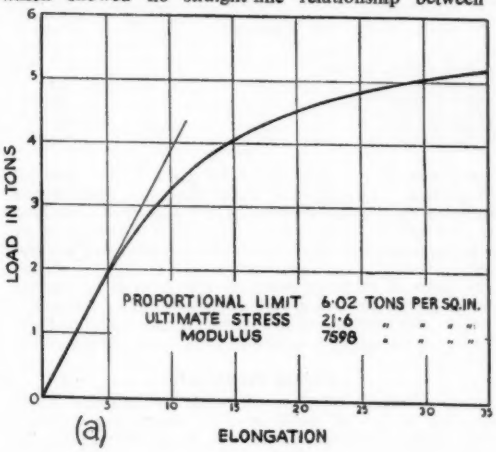


FIG. 5.—CHANGE IN TENSILE STRENGTH WITH CASTING THICKNESS.



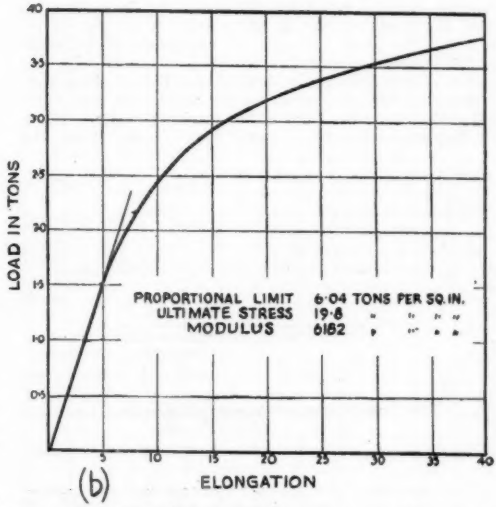


FIG. 6.—STRESS-STRAIN DIAGRAMS FOR MEEHANITE (*a*) AT ROOM TEMPERATURE, AND (*b*) AT 400 DEG. C. (ONE UNIT IS 0.05 MM. ON A GAUGE LENGTH OF 2 IN.)

The Engineering Properties of Meehanite

TABLE I.—*Typical Yield and Ultimate Breaking Strengths for Various Engineering Materials.*

Material.	Ultimate breaking strength in tension, tons per sq. in.	Yield point in tension, tons per sq. in.	Per cent. yield to breaking stress.
Cast steel 0.25 per cent. carbon	28.0	17.8	53
Mild steel normalised ..	34.0	17.0	60
Malleable cast iron	25.0	17.0	68
Admiralty bronze	20.0	11.0	55
Meehanite type GA as cast	24.5	21.0	84

stress and strain, does not hold good in the case of Meehanite. That this is so, is clearly shown in the stress strain modulus curve of the GB type, obtained at atmospheric temperature (Fig. 6(*a*)). The curve in Fig. 6(*b*), which represents the result obtained on the same material at a temperature of 400 deg. C., shows that even at high temperature the material possesses elastic properties and a very definite range of plasticity.

The straight-line relationship is not confined to tensile stressing, but is found equally in compression and torsion.

Fatigue Properties

It is unusual for metals to fail under static loading, the source of most of the engineering failures being fatigue. In fatigue failures, even soft and ductile metals like copper, nickel and mild steel finally break because a crack has been produced and is propagated until the cross section is so reduced as to be unable to carry the load. Fatigue or endurance is a fundamental property that has to be considered with the tensile characteristics in designing. Fig. 7 shows endurance curves of ordinary iron, alloy iron and high-test cast iron made by the Meehanite process. Those for the grey iron, alloy cast iron and type B are the results of tests carried out on specimens cut from the 6-in. blocks of the materials previously referred to. These results are compared with those for other materials in Table II. There are two reasons for the favourable showing of the new material with other types of structural metals:—

(1) Meehanite has the property of crackless plasticity which permits of an occasional overstress without the development of a crack that in later service would spread to fracture, and (2) it has a high damping capacity for vibration which prevents resonance stresses from building up to critical proportions. In other words, the internal friction of the metal converts the energy of vibration into heat and disperses it. Damping does not foretell impending fatigue failure, nor does it tend to disappear under prolonged cyclic stressing. On the contrary, it is capable of dissipating an unlimited amount of energy as heat without damage to the material. Ultimate damping, that is, the steady value attained after some millions of cycles, is often greater than initial damping.

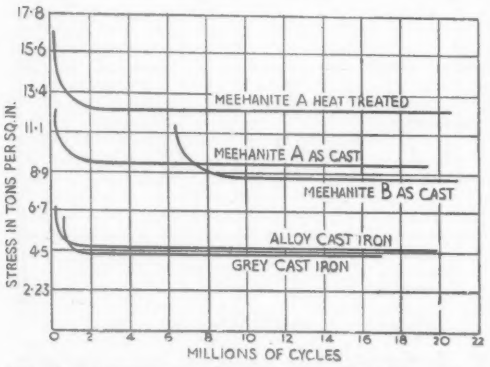


FIG. 7.—ENDURANCE CURVES FOR SELECTED CAST IRONS.

TABLE II.—*Endurance Limits for Engineering Materials.*

Material	Endurance limit, tons per sq. in.	Endurance limit per cent. of tensile strength.
Malleable cast iron	10.7	53
Steel casting (0.30 C)	13.4	40
Steel forging (0.37 C)	13.4	44
Welded steel structure	5.3	30
Ordinary cast iron	4.0–5.3	43
Meehanite GA, as cast	9.4	40
Meehanite GA, heat treated	12.5	—
Meehanite GB, as cast	8.6	47
Alloy cast iron	4.7	34
Grey cast iron (steel mix)	4.5	42

The importance of having available a material which can absorb vibration stresses rapidly is appreciated by the engineer. This is one reason why cast iron has been extensively used for parts where vibration has to be reduced to a minimum. Unfortunately, in ordinary cast iron, the damping capacity falls as the tensile strength increases. This also applies to Meehanite higher processes; but as a result of research a method has been evolved for a special processing of the high-strength metal, whereby the damping capacity can be increased to nearly the same as that of a soft low-strength cast iron.

Toughness

The property known as toughness is something which is difficult to define, but is commonly understood to be the opposite to brittleness. In the majority of cases there is no definite line of demarcation between toughness and brittleness. Cast iron has been described as a brittle material because it breaks without showing appreciable plastic deformation, but this is not so in the case of high-duty irons. A reference to the modulus curves in Fig. 6 (*a*) and (*b*) shows that there is a very definite plastic range between the yield point to the point of fracture.

(*To be continued*)

New Precision Casting Process*

By Herbert Chase in collaboration with Leslie T. Schakenbach, Precision Casting Engineer, Sperry Gyroscope Co. Inc.

One more casting process has been adopted by the Sperry Gyroscope Company plant at Great Neck, N.Y., in its constant attempt to produce castings which must meet exacting specifications. The latest process is a variation of precision casting in which frozen mercury replaces the wax most generally used in investment casting. This method is patented and is known as the Mercast process.

Although most castings in this range of sizes and alloys produced by Sperry are made by the wax investment method, the Mercast method is being applied more widely as experience is gained in its use. The use of frozen mercury offers greater dimensional accuracy, superior smoothness and accuracy of detail. Some stainless steel and coin silver castings have been made by Sperry by the Mercast process, but most of the castings have been of Alcoa 356 alloy.

For the Mercast process, pattern making and investing are altered from procedures used in conjunction with wax investment materials. Such changes are necessary because of the different materials involved. For instance, since mercury freezes at −40 deg. C., a pattern made from it must be chilled to below this temperature to solidify and hold its shape until investment is completed. The Mercast process as carried out at Sperry is as follows:—

Patternmaking

The mould for making the pattern is built in much the same manner as for wax but with a different allowance for shrinkage and with a sprue hole or holes formed within the mould in place of the injection opening used for wax. When assembled, the mould is placed on a bench and is first filled with acetone, which acts as a lubricant. Then mercury at room temperature is poured into the mould from a beaker and displaces the acetone. The mould joints are tight fitting and prevent any mercury leakage. When thus filled, the mould is placed in a cold tank for freezing. This tank has 10 in. of cork insulation on the sides and 12 in. on the bottom. The top is open along two sides of a central box containing dry ice, but this box is kept covered. The box, which is of stainless steel, has its lower portion immersed in methlylene chloride to a depth of about 24 in., the liquid being under as well as around the box and to a depth of 28-in. around the box. This liquid is non-inflammable and non-toxic, and is chilled by the dry ice in the box to −60 deg. C.

In this cold liquid, the mould is nearly submerged, resting on a platform, until the mercury freezes. A bent wire rod placed in the sprue hole freezes in the mercury and provides a convenient means for handling the pattern. As the mercury contracts somewhat in freezing, more mercury is sometimes added while freezing proceeds. Suitable allowance is made for the shrinkage of the metal to be cast, of course, in designing the mould, but no shrinkage allowance is required for the mercury itself. In general, it takes about 10 min. for the pattern to freeze. The mercury pattern reproduces sharply all mould details. Then the mould is opened by an operator using gloves, while the mould rests on a wooden platform that is barely submerged in the refrigerant.

Investment

As the pattern, which looks like and is about as hard as lead, must be kept frozen and free of moisture condensed from the atmosphere, each pattern is immediately submerged, suspended from the wire handle in another cold tank until ready for investing. This tank is also cooled by dry ice, but contains no other refrigerant. In a larger tank are small containers for the liquid investing slurry, which is kept at about −60 deg. C. or well below the freezing point of the mercury.

When dipped in the slurry (crystobalite), the pattern, held by the wire in gloved hands, is tilted and turned until all surfaces are coated. Then the pattern is left to drain for about 15 to 30 min., during which time other patterns are being similarly coated. Thereafter, the pattern is re-dipped several times at about 15 to 30-min. intervals until a satisfactory thickness of coating is built up.

In general, 8 to 12 dips are enough to provide a shell of sufficient strength, say from ⅛- to ¼-in. average thickness. If, especially for large moulds or those to be cast centrifugally, greater mould strength is desired, the shell formed by dipping can be set in a supporting investment in a flask before baking is done.

The mix used in the dipping investment includes solid refractory ingredients, and the smoothness of the inner wall of the investment (which contacts the metal to be cast) affects the smoothness of the casting. For greatest smoothness, the pattern must be smooth and the refractory particles as small as feasible. At Sperry, refractories that pass a 500-mesh screen are used, but those passing 1,000 mesh are available.

Pattern Removal

When the dipping investment is complete, the mould thus formed is placed on a bench where heat is absorbed from the atmosphere. This results in the mercury becoming liquid and it flows out to the drain hole at the centre of the bench. From there the route goes through a water seal into a container from which the mercury is passed through a cleaning cascade. The mercury is thus cleaned of any refractory or impurities and is collected in bottles for re-use.

As the mercury never attains a temperature above that of the room and is never touched by hands, the chances of mercury poisoning are considered negligible.

*Extracted from *Materials and Methods.*

New Precision Casting Process

This conclusion was reached after careful consideration by insurance and other authorities. Nevertheless, there are exhaust vents around the mercury bench and mercury vapour indicator alarms are provided, especially near the mould baking ovens. No indication of any mercury vapour has ever been found, and any vapour from the small amounts of acetone used is quickly exhausted by the ventilating system.

Drying and Firing

When the moulds are free of mercury, they are dried at 90 deg. C., are fired at about 1,030 deg C., and then cooled to the temperature best suited for the alloy to be cast in the moulds, much as for moulds made with wax patterns. Casting is also done with the same equipment. Advantages attained with the mercury patterns include smoother surfaces; less pattern distortion; ability to attain sharper corners and thinner sections at edges; ability to hold significantly closer dimensions and feasibility of using larger patterns than for those made in wax. Important results include more precise dimensions and smoother surfaces on castings if the pattern mould cavities are polished sufficiently.

Conclusions

With the Mercast process in this plant, dimensional limits have been held within ± 0.003 in. for dimensions up to $1\frac{1}{2}$ in. and, on some smaller dimensions, limits as close as ± 0.001 in. have been held at certain critical points in making aluminium castings. It does not follow, of course, that these very close limits apply to all dimensions or to all castings, even at critical points. The closer the dimensions specified under ± 0.003 in., the higher is the reject rate. Other factors, such as the shape and size of casting, wall thickness and care in all phases of the processing affect the results that have been secured.

In general, however, the Mercast process has been found to permit closer control on critical dimensions than when wax patterns are used. Thus far, processing has been somewhat slower and costs somewhat higher than where wax has been used. But, as yet, experience with the Mercast process has been quite limited. Further experience may alter to some extent such conclusions as have yet been drawn.

Casting of investment moulds is substantially the same for both types. Most Mercast and all lost-wax moulds are cast centrifugally and all melting for both types is accomplished in induction furnaces of the Ajax Electro-thermic type operating at 3,000-cycle frequency. Two furnaces of 50 kva. and two of 20 kva. are available. The larger ones, more recently installed, are intended especially for ferrous metals and the smaller for non-ferrous, but either type can be used for ferrous or non-ferrous metals.

FOUNDRY EXECUTIVES interested in the "Walbro" cupola, which was referred to by Mr. W. W. Braidwood in a recently printed Paper, can see one in operation by arrangement with Mr W. Walmsley of 48, Dove Lane, Darwen, Lancs.

Book Reviews

Bibliography on X-ray Stress Analysis. By Herbert R. Isenburger. Published by the St. John X-ray Laboratory, Califon, New Jersey, U.S.A. (Mimeographed.) Price $3.

The most useful part of this 17-page pamphlet is the subject index, for the 240 references listed mean but little by themselves. The few references to British authors cause one to wonder whether we are backward in this field of research or whether the listing is incomplete. However this may be, a specialised bibliography of this character is bound to be useful.

10 Kapitler om Moderne Stoperidrift (Ten Sections of the Modern Foundry Industry), by John Sissener. Published in the Norwegian by *Studieselskapet for Norsk Industri* (the Society for the Development of Norwegian Industry) from Oslo.

The sections covered in this well-illustrated, 300-page mimeographed report are headed: (1) Planning and layout of foundries; (2) roller conveyors and mechanised foundries; (3) sand systems and sand treatment; (4) Sandslingers; (5) wet cleaning processes; (6) mechanical charging of cupolas; (7) cement moulding; (8) centrifugal castings; (9) cast iron, Meehanite and electric melting of iron, and (10) sand reclamation. The information upon which the report is based was largely obtained as a result of a four months' tour undertaken in 1946 by the Author. The tour embraced the United Kingdom, Sweden, Finland and Denmark. Statistical and general reviews are given of each of the countries visited, except Great Britain.

The reviewer's ignorance of the Norwegian language is not so profound as to prevent him from expressing his belief that the Author has done his task exceedingly well, and our Swedish and Danish readers will share with Norwegian foundrymen the many benefits which are obviously to be gained from study of this book.

V. C. F.

House Organ

"Group," March, 1948—the house magazine of the Marshall Organisation. The magazine has to cover the activities of four distinct works: Marshall, Sons and Company, of Gainsborough; John Fowler and Company (Leeds), Limited, of that city and Sprotborough and Marshall Richards Machine Company, Limited, of Crook. This particular issue carries a special supplement in order to record some of the happenings at Gainsborough, as 1948 was the centenary of its establishment. The issue is the first one the reviewer has seen and he sincerely praises the Editor for the high standard achieved. Yet the magazine might be improved, even if it meant sacrificing some of the excellent photographs used, by the insertion of paragraphs listing (and thereby welcoming) new apprentices, and by devoting more space to the sporting activities of the various concerns, in addition to chess and angling.

Casting Inspection*

How a Modern Need for the Maintenance of Quality in Castings is achieved

By J. Howard Williams

(*Continued from page* 312.)

Salvage of Defective Castings

Acetylene Welding of Cast Iron.—A well "preheated" acetylene welded job is almost as good as a normal casting, and the method can be used with confidence on many defectives, but in the Author's opinion should not be used in such places as cylinder bores, bearings, machine-tool slides, or any surface which has to withstand friction and wear evenly. When the Author actually *sees* a weld which is of exactly the same composition as the surrounding casting, and of exactly the same degree of hardness as the casting, both in the centre of the weld and at its junction with the casting, he will believe it possible.

Pressure-tight acetylene welds can usually be relied upon when the casting is preheated beforehand, and in some cases, also, when the weld is made without preheating. Welding without preheating is often suitable where the weld is "out in the wind," *i.e.*, in such a position that normal weld shrinkage can take place, without setting up dangerous stresses and strains in the casting. The inspector should never sanction either weld or "burn-on" on a casting which has to be shock-proof; stresses and strains in the region of the repair will often cause a fracture after the casting has been in use for some time. Whether or not a casting can be salvaged by welding is largely dependent on the quality of the welding facilities available, and the inspector must make his decisions accordingly.

Electric Welding of Cast Iron.—The Author's experience of electric welding of cast iron leaves him at present with little confidence in it, so far as strength, reliability, machinability, and even appearance on machined faces are concerned. Electric welds on cast iron have their uses, however, and the Author is keeping an open mind on the subject; the technique of welding is always advancing, and he would be agreeably surprised to see in the near future an "electric" cast-iron weld which is:—(*a*) Indistinguishable from the casting on a machined face; (*b*) not troubled by hardness on the line of fusion with the casting; (*c*) not liable to contain numerous small cracks; and (*d*) which is a real addition to the strength of the casting, not just a filler.

The inspector should use electric welds on cast iron as fillers where it only affects the appearance of cast surfaces, and on machined surfaces where there is no friction. As a means of rectifying faults where the metal must be pressure-tight, or of strengthening a weak point, the adoption of electric welding, even the use of Monel metal electrodes, is unwise.

Burning-on.—This method of rectification is quite good on *suitable* defectives, *if it is done by experts*; if not, it shows all the bad points of a badly done weld, only more so.

Plugging.—The use of plugging on non-machined surfaces to stop a leak, or to correct appearance, is a very reliable method of rectification, and should be used to a reasonable extent, if needed. If the operation is properly supervised, it is a 100 per cent. efficient job.

Iron Cement.—A good iron cement, used to correct a minor fault which only affects the casting's appearance, is quite a good form of repair which in no way harms the customer. A good working knowledge of some forms of salvage, not generally used *before* machining, is very useful to the casting inspector; it helps him make his decisions on castings, which although they cannot be salvaged in the foundry, can be quite easily salvaged after machining.

Core and Mould Scabs

Liners.—The use of liners, or tubes, for the salvage of porous or otherwise defective castings, is usually a reliable form of repair, but decidedly expensive. Whether or not this form of salvage is likely to be used is a matter which concerns the customer, but a comprehensive knowledge of the customer's requirements is useful to the casting inspector occasionally.

Bakelite and Rusting (Sal Ammoniac).—Bakelite treatment, or rusting, used as a cure for small leaks due to porosity, which have been found during machining or hydraulic test, as generally quite satisfactory. The Bakelite treatment needs a mechanical contrivance of some sort for forcing the varnish into the porous casting under pressure; also some arrangement for baking the casting at a controlled temperature; but it is quick, cheap, and permanent.

Rusting is cheap enough, but is an extremely slow process. The use of either of these porosity fillers on rough castings before they leave the foundry shows a regrettable lack of confidence in the ability to produce pressure-tight castings, and proves that a spirit of defeatism is present in the foundry staff.

The casting inspector, if he makes his decisions regarding border-line salvage cases correctly, will inevitably discover that the machine shop, or customer, thinks he is not quite strict enough, and that he salvages some castings which should be scrapped. From the foundry he will hear the opinion that many castings he scraps could have been, and should have been, salvaged. If both sides, having diametrically opposite viewpoints, say the inspector's decisions are not quite right, he should be pleased to know his views regarding salvage strike "dead centre"; it is obvious they must be very nearly

*A Paper forming the basis of a lecture to the Wales and Monmouth Branch of the Institute of British Foundrymen, Professor Jones presiding. The Author is Castings Inspector with Holman Brothers, Limited, of Camborne, Cornwall.

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correct. If, on the other hand, the machine shop or customers think he is a perfect inspector, and the foundry is certain he is a perfect tyrant, or *vice versa*, the inspector's judgment is evidently badly biased, and he had better revise his opinions drastically and speedily, if he wishes to keep his job.

Welding of faults in steel castings is largely applied common sense and economics. If a steel casting be annealed after welding, there is no reason to suppose the region of the weld will be any weaker than other parts of the casting.

Inspection of Classified Types of Defects

On castings which have to be pressure-tight and extensively machined, a scab means scrap nine times out of ten. The appearance of the casting at the point where scabbing took place can usually be corrected by the fettler quite easily; the real *cause* of scrapping is always the amount of loose sand set free in the casting when scabbing occurs. The sand is often difficult to find, and even after a most thorough foundry inspection it is liable to be found only by the machine shop; therefore, when in doubt, "scrap." The nearer the scab is to the bottom of the mould, the greater the danger of scrap, as obviously the loose sand has a greater area in which to choose a resting place, and out of "natural cussedness" it usually lodges in the spots which are most difficult to find, and also those which are the most dangerous.

When sand is found on surfaces to be machined, the pick, or a similar tool, will often reveal the extent of the damage, and the inspector can make a fairly safe decision. When the sand is found in a wall of the casting which has to be pressure-tight, this usually means scrap; the inspector will find testing with paraffin an invaluable guide in such cases. Attempts at rectification of scabbed castings by use of plugs are very liable to failure; often, after the inspector has plugged the defects he has found, more will be found during machining, and scrap results. Before deciding to use a scabbed casting which has to be highly machined and/or be pressure-tight, the inspector must investigate all visible signs of sand deposits, no matter how small, or he will soon notice an upward trend in his "percentage returns from customers." If the unlikely happens, and the inspector decides to weld a scabbed casting, the fault should be shot-blasted, or the sand deposits, often invisible, are likely to cause a bad weld, and the welder is often in danger of taking up permanent residence in "hades," due to the descriptive language used.

Leakages due to sand deposits from scabs, or similar causes, should never be salvaged by the "rusting" method. Sand will not rust, and even if the leak be apparently sealed after "rusting," changes of temperature, vibration, *etc.*, will often cause the leakage to reappear when the casting is put into use. All scabs, especially those which are recurrent, must be reported promptly to the foundry foreman, who must then find the cause and cure for them; he has sources of information which the inspector lacks, and the inspector should only record the cause of the defect after consultation with him. Amongst the various causes of scabbing are: hard ramming, imperfectly dried moulds, sand faults, lack of vents, "drawing down" of a flat top (covering of the risers is often the cure). A "steamy" mould will often cause scabs on cores, without any apparent blemish on the mould surface. These, and some other less common reasons, combine to make a diagnosis of the real reason for the scabs difficult. A form of defect which is often mistaken for a scab, or a crush, is a series of cracks which occur in mould surfaces during oven drying. These cracks appear to be regarded by most moulders as an unfortunate law of nature, regarding the prevention of which nothing can be done. In the Author's opinion, mould cracks cannot be entirely eliminated, but *can* be made less frequent and dangerous, by careful attention to the position of ribs, supports, *etc.*, in the box, and to the relation of the shape of the box to the shape of the casting produced in it. The moulder's only rectification of such cracks is often only a normal application of blacking, which *appears* to be effective, but metal often enters such weak places, and defects which resemble scabs occur. When such mould defects appear to be dangerous, they should, and could, be easily made perfectly harmless by any good observant moulder.

As some scab causes are due to moulders' and coremakers' mistakes, whilst others are due to lack of supervision, the recording of the stated *cause* of scrap should be carefully checked, especially in cases of payment by results. Scabs on large, heavy-section castings, where the casting is not to be extensively machined, are proportionately less dangerous than on high-class castings of approximately $\frac{5}{16}$-in. thickness, but the wise inspector will never trust a scabbed casting very far.

Loose Sand

Loose sand is generally caused by careless or clumsy moulders. The most careful moulder is liable to let some sand drop into his mould during assembly, especially if the job be highly cored, but a careless or unobservant moulder often neglects to remove it. The major portion of a deposit of loose sand usually sticks in some corner or recess at the bottom of the mould, but some washes up and may be found in any part of the casting.

Loose sand is not such a prolific scrap producer as scabs, but a very careful inspection, on the same lines as for scabbing, is necessary. If the inspector decides that a casting can be salvaged by welding, the defect should first be shot-blasted. Where the defect only affects the casting's appearance, and is not large, quite a good salvage job can often be done with iron cement. Loose sand which washes around freely in the mould rarely causes leakage; it seems to stick in small deposits to the side or top of the casting, and the extent of the damage can usually be found with the aid of a pick. The inspector must promptly report cases of loose sand to the foundry foreman, whether scrap occurs or not; a few pointed remarks from him on cleanliness may save an avalanche of trouble in the next batch of castings from the careless moulder.

Crushed Castings

Crushed castings sometimes result from a badly-made core, plus lack of core inspection, or from a pattern fault, but more often are caused by bad moulding; they are rarely received from a good moulder. When a "crush" occurs, scrap is very often the result; lumps of sand break loose and form holes in the casting, which are often large, jagged and irreparable by salvage operations. If salvage by welding is considered suitable, the same rules apply as for scabbed castings. "Crushes" must quickly be reported to the foundry foreman, to enable him to discover the cause and so prevent further scrap from the same reason.

Bad Moulding

This heading covers all the otherwise unclassifiable faults the moulding fraternity is heir to, up to and including miracles; cases of bad moulding are generally so obviously scrap that little inspection is needed. Here are a few examples of faults which the Author classifies as bad moulding:—Run out; allowing the top of the mould to rise during pouring; putting on the top box wrong way round; the washing away of badly-made runners; omitting a core; the moving of badly-secured cores during pouring; wet moulds (in the case of green-sand, due to the adding of water by the moulder); pods washing off due to their not being reasonably reinforced by brads, or other similar securing devices. As for miracles (*i.e.*, moulding results which are apparently impossible), well, the improbable is always happening in a foundry; the impossible is less frequent.

"Off-set" or "Odding"

If the inspector receives a casting, or batch of castings, which are off-set, he must first check, through the foundry foreman, the reason for this defect. Often, when a large number of the same type of casting is off-set, it is due to "pattern defect," and the defectives must be recorded under this heading, *not* as "off-set," which is due to foundry fault.

"Off-set" castings are usually due to lack of care by the moulder, or to defective moulding equipment (such as boxes and pins), which are the responsibility of the maintenance staff and, ultimately, of the foundry foreman. "Off-set" castings due to moulding faults can generally be identified by the inspector without much room for doubt; castings will vary from correct to hopelessly defective, and he will rarely find two in a batch which are off-set by the same amount or in the same direction. If castings are defective due to their being "off-set," no general rule can be laid down regarding scrapping; each variety of casting must be considered individually. Where in a particular job dimensional latitude is practically non-existent, it means they are scrap, but where a little latitude is permissible, a good fettler can often rectify the appearance. Furthermore, the amount of "off-set" must be considered in proportion to the size of the casting.

Sometimes the fettling department—maybe with the best of intentions—tries to "rectify" off-set castings without first consulting the inspector. This is really a form of "inspector blinding" and should be stopped at the first opportunity. After the inspector has scrapped a batch or two of off-set castings, which the fettler fondly imagines he has "put right," "rectification" of off-set castings stops quickly and permanently.

Slag Inclusions

If slag is a recurrent fault in a casting, a report must be made to the foundry foreman; the slag trap on the mould may be inefficient. The presence of slag in a casting *may* indicate that pouring was stopped for a time, due to a "run-out." Such defective castings, although they may appear usable at first glance, are often scrap. The inspector must check the casting very carefully with pick and paraffin, and examine it closely for signs of a "line of non-fusion," which is usually termed "mis-run" or "cold-shut"; the verdict after checking in the foundry is, of course, not "slag" in such cases, but bad moulding. Occasional slag inclusions are generally due to accidents while the casting is being poured; very little can be done by the foundry foreman to prevent this, and less by the inspector. The inspection of such defective castings is fairly easy; that is, remove the slag with a pick to reveal the extent of the damage, and then the inspector can make a fairly safe decision, often by a straightforward measurement. If a form of slag becomes fairly general on the majority of castings (even if the damage is slight), the matter should be inquired into by the foundry staff without delay; it is quite likely a fault at the furnace, probably some small change in technique, intentional or accidental.

Gas-holes (Moulding)

The inspector will almost always find these gas cavities on top of the casting, as poured. Holes that break through are, of course, obvious, but considerable experience, a keen eye, and the use of the pick are needed to find those which are concealed by a thin layer of metal. When a gas cavity is covered by a layer of metal, the "skin" of the casting is inclined to "shine," is smooth, and is always of a different hue from the solid parts; a tap of the pick on such spots will often give surprisingly convincing results. If the inspector suspects the presence of gas-holes, he should use the pick, and use it "plenty," not "pulling his punches." When the gas-holes are small and numerous, he should never assume he has found them all—he never has!

Generally speaking, a casting which is known to contain gas-holes, and has to be machined, should be scrapped. Nine times out of ten, more gas-holes will show up during machining; then the casting will be scrapped and the percentage of scrap due to casting faults after machining goes up, and the reputation of the inspector goes down in proportion. Gas-holes, for which the moulder is to blame, can be caused in many ways, such as: metal in the core vents; blocking of core vents; not venting the mould correctly; adding of moisture to a green-sand mould, *etc.*, but as there are so many ways in which gas-holes can form which are not the fault of the moulder, the inspector will be wise to consult the foundry foreman before recording the reason for such defectives. If a defective casting, due

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to gas cavities, is considered suitable for salvage by welding, little trouble will be experienced by the welder; gas-holes are invariably clean.

Core Faults

Blown Core.—If a core "blows," there is rarely any hope of salvage, but the "blow" must be reported promptly to those concerned; they can then try to discover why the core failed, and so prevent further scrap. The "blowing" of a core is just as likely to be due to bad moulding as to badly vented or insufficiently dried cores, or even to the use of an incorrect core-sand mixture.

Scabbed Cores.—A core scab usually means scrap, the loose sand set free by the scabbing being generally deposited in a vital spot if the core is horizontal; the chances of salvage after a vertical core scab are better, the sand sometimes being washed up into a riser.

Cut, or "Washed" Cores.—Cores which have had portions "cut" or washed away during pouring present a problem for the inspector, in some ways similar to that of loose sand, but the extra metal at the point of "washing" may also cause scrap. This type of core failure may be due to a variety of reasons, not all because of core faults, such as: incorrect runner position; pouring temperature too high; use of a weak core sand; refractory coating (blacking) not correctly applied, or of wrong composition. In fact, only a small minority of "washed" or cut cores are due to core faults. Core failures, the actual cause of which is debatable, should be reported by the casting inspector to those in charge of both core-making and moulding; as neither wants the blame for the defective castings, the real reason for the core failure is soon found, and further scrap prevented.

Broken Cores.—Cores with portions broken off prior to casting naturally cause no trouble due to loose sand, but the extra metal often causes scrap due to the difficulty or impossibility of its removal. This fault is

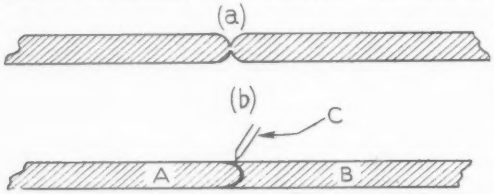

FIG. 10.—TYPES OF "MISRUN" DEFECTS: (*a*) EASILY IDENTIFIED, (*b*) DIFFICULT TO IDENTIFY.

usually due to either inefficient core inspection or careless handling on the part of the moulder.

Off-set Cores.—If a core be off-set, scrap is the usual result. This failure often occurs during the sticking together of cores if the core-maker be inefficient (and the core inspector also). If there be no form of core inspection in operation in a foundry, it should be introduced; it is one of the most effective primary scrap preventives.

"Burnt-in" Cores.—"Burnt-in" cores sometimes cause scrap on intricately cored castings, due to the impossibility of removing the mass. This is not surprising, as the Author has found such "cores" may contain as much as 70 to 80 per cent. iron. The reception of castings containing "burnt-in" cores in the fettling department is an education to those who are a little weak in descriptive language.

Breakages in Fettling and Transit

Breakages, such as projecting portions broken off or castings broken in two, are of no trouble to the inspection department, the extent of the damage being obvious, but "hair-line" cracks are one of the most difficult faults to detect during foundry inspection. These practically invisible fractures are almost invariably the result of breakages in fettling or transit. A "hot break" or "draw" is plainly visible as a rule, the fracture being of much greater width than a cold fracture. Detection of fettling fractures can be carried out efficiently only if all available methods of detection are made as routine inspection on all castings which are liable to fractures.

Here are a few suggestions:—Make a *close* observation; a crack which is invisible at 3 ft. in ordinary light is often plainly visible at 6 in. under a powerful light. The sounding of a casting with a pick or hammer will often reveal the presence of a fracture which is definitely invisible, owing to its being under compression, dirty or very minute. If there be an external reason to suspect the presence of a fracture, such as hammer or chisel marks at a weak spot in the casting, use a "paraffin and chalk" test.

When the inspector scraps a casting because of a "fracture," he should always check the thickness at the point of breakage; breakages by fettlers are not *always* the fettler's fault. Breakages during transit from foundry to fettling department can only be prevented by the foundry foreman, and should be reported to him. The percentage of scrap due to breakages can easily be kept within reasonable limits by attention to the following points:—Keep "frasing" or "flash,"—*i.e.*, scrap metal around core-prints, *etc.*—within limits in proportion to the size of the casting. If there be the slightest danger of fracture of the casting through breaking off risers with a sledge hammer, then cut them off by machinery or use "Cameron" cores. If an abnormal amount of breakages, due to carelessness or clumsiness, are frequently received from one fettler, the remedy is obvious.

Scrap due to the fettler's removing too much metal when chipping or grinding a casting is rare, but not unknown; the average fettler is far more likely to leave too much on. Defectives of this type are entered under "Fettling Shop" on the weekly "defectives sheet."

Scrap Due to Lack of Control

The word "Control" is a short word, used to head a column on the weekly "defective sheet," which is understood to cover "defectives due to mistakes and accidents which are the responsibility of foundry supervision." For instance, moulds in a "steamy" condition, due to insufficient drying, will produce castings

which are defective due to scabs (of mould or core) and gas-holes, but the inspection-sheet classification, after checking in the foundry, must be recorded under "Control." Supposing the crane accidentally strikes a riser or runner cup and sand falls into a mould ready for pouring; if the foreman takes a risk and runs the casting, it would appear that the defect is due to "loose sand," which is a moulding fault, but actually, of course, the verdict should again be "Control." "Control" also covers "short run," *i.e.*, trying to pour a casting with insufficient metal in the ladle. The inspector can usually tell the difference between "short run" and "run out" (which often gives a very similar effect) by noting two points, *viz.*, the top of a "short-run" casting is generally fairly level, and on light sections often convex, but a "run out" is rarely level; light sections are concave and heavy sections very much so. These, and many other possible causes of defectives, will at times come under the heading of "Control"; they also plainly illustrate the need of frequent visits to the inspection department by the foundry foreman.

The inspector may sometimes incorrectly record the reason for a defective casting if information regarding the real reason is not available; the foundry foreman has sources of information which the inspector lacks. The foundry foreman, in the company of the inspector, should examine all rejected castings at least once per day; this not only ensures a fair deal for all concerned, but obviously can do a great deal of good in many ways. It will sometimes be found a good policy regarding scrap prevention if the foundry foreman calls the moulder or core-maker responsible for defects to the inspection department, and views the castings in their company. This may be looked upon as a form of "rubbing his nose in it"; so it is, to a certain extent, but, as is known, the inspector is not always right and the foundry foreman can sometimes prove it. Strange as it may seem, if the moulder be given a chance to speak for himself, he can sometimes prove both inspector *and* foreman to be mistaken. Finding the true reason for defectives is the first essential requirement for their prevention; and the method of finding it is immaterial so long as it works.

Misrun and Cold-shut Castings

The proportion of "misrun castings" which can be put into service is so small that it is negligible. Partially fused misrun castings are difficult to inspect; often paraffin will not seep through and the inspector may be tempted to use them. He should not. Fig. 10 (*a*) shows a sectional view of one type of misrun defect which has the edges fused together for approximately a quarter of the thickness, leaving a "V"-shaped depression on both sides.

FIG. 11.—EXAMPLES OF "MISRUN" CASTINGS.

The strength of the casting is obviously reduced by at least three-quarters; the two "V"-shaped faults may be of any length up to the entire width of the section, and these faults weaken the casting just as effectively as two chisel cuts would; the only safe place for such castings is on the scrap pile. Misrun (*a*) is easily seen, but the misrun (*b*) (Fig. 10) is very often not so clear; all that is visible on the casting surface are lines similar to cracks, but apparently of little depth. Close examination, however, will reveal in what direction the fault runs, and the extent of the misrun can be proved by using a chisel, as shown at C in the sketch. If the metal has not fused, pieces will chip off easily, exposing a purple-blue surface, smooth and shining, beneath. Although the proportion of fusion is often greater in this type of misrun, it is usually wise to scrap the casting. The reason for this type of misrun is probably a difference in temperature in parts A and B when they meet. A is the coldest metal and has already solidified when the metal B touches it; B metal is hot enough to run the thin edges (which are later chipped off during inspection), but is not hot enough to cause complete fusion with A.

Fig. 11 shows castings with "misrun" defects of the second type. On the right is part of one casting which has an apparently minor flaw visible on the surface; a curved line adjacent to a small area of smooth, shining surface being the sole external evidence. On the left is shown a portion of a casting of the same type, which has been broken at the point of non-fusion. The shining portions show clearly to what extent the casting had failed to join, the small rough spot at the centre being the only place where some degree of fusion had taken place. It is obvious that the inspectorate is justified in rejecting all such defectives; in this case the casting would almost certainly have broken during a turning operation and would, in any case, be rejected on final inspection, the defect becoming more apparent after machining.

"Misruns" are always found in a thin section of the casting, usually near the top and far from the runner. The chief cause of this defect is the use of "dead metal," *i.e.*, metal which is at too low a temperature to run the casting. Other causes of "misrun"

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may be use of runners which are too small or runners becoming choked, but these are rare.

Shrinkage Defects

The Author classifies shrinkage defects in four distinct forms:—(1) Surface cracks, or those running right through the section (the latter may be termed a "hot-tear"); (2) surface depressions; (3) porosity, and (4) cavities under risers.

Surface Cracks.—When a shrinkage defect resembling a crack is found on the surface of a casting, usually on a heavy section and near a riser, the inspector should never pass the casting unless he is quite sure the casting will do the work required of it. Surface cracks, no matter how small, are generally an indication of serious shrinkage, often to a considerable depth. X-ray examination should be of considerable assistance to the inspector in such cases, if it be available. If a batch of castings be defective in this way, and no X-ray examination can be carried out, the inspector should cut up one casting to reveal the extent of the damage, and then base his decision on the whole batch on the extent of the shrinkage exposed.

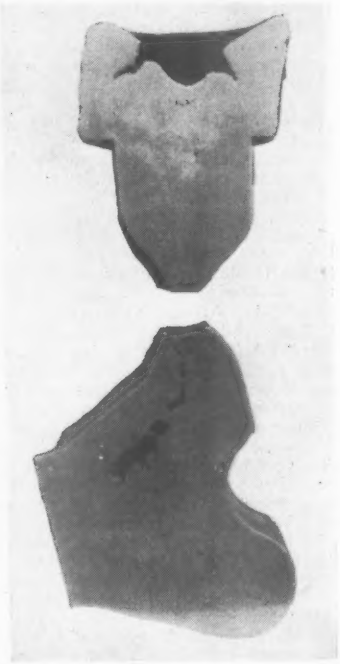


FIG. 12.—CASTING AND ITS RISER, SECTIONED TO SHOW COMPLICATED SHRINKAGE DEFECT.

Fig. 12 is a photograph of a casting and riser sectioned to show a complicated case of the "cavity under riser" type of shrinkage. The metal used was high-duty iron of 25 tons tensile. Pouring temperature was slightly under normal, but the metal was by no means "dead." The chief cause of this shrinkage is the obviously inadequate riser used. The top of the riser is of the correct diameter, but the smaller bottom section did not remain liquid long enough to feed the casting. If the pouring temperature had been normal, or above normal, it is quite probable that the shrinkage defect would not have occurred, or would have been negligible; also, it is quite possible that, if a metal of appreciably lower tensile strength had been used, the riser would have done its work.

In the Author's opinion, all risers on high-duty iron castings should be of a size which gives a generous margin of safety, sufficient to cover any reasonable variation in temperature, fluidity, *etc.* A few pounds weight extra on a riser will often prevent many pounds' worth of castings appearing on the scrap pile. Running into the riser is an effective safety measure on many castings, but this method is of little use where several risers are distributed over a fairly large area. There were three risers on the casting referred to in this case.

The inspector's decision to cut the casting, as a test case to cover others cast at the same time, was mainly based on the following four points:—(1) Shape and diameter of the riser left much to be desired; (2) an apparently negligible shrinkage mark, observed after the riser was removed, though it would not permit the insertion of a $\frac{1}{32}$-in. inspection wire, would just "drink" paraffin; (3) a knowledge that a very high-grade metal was used; (4) a consultation with the foreman in charge of the furnace elicited the information that the metal temperature was slightly under normal; the few small gas-holes visible just under the "skin" of the casting are probably due to this condition. The whole casting was approximately 3 ft. by 2 ft. by 7 in. deep.

Cracks Extending through the Section.—"Crack shrinkage," "hot-tear," or "draw," meaning a fissure caused by shrinkage which goes right through a section of the casting, is, as a rule, quite distinctly visible; there is only one place for such defective iron castings—the scrap pile. The fault may be caused by metal faults, moulding technique, hard cores or pods, or even by incorrect design, but on iron castings it is not a common fault. On steel castings this "hot-tear" defect is only too common, and is usually due to internal cores or pods being too strong, their resistance to shrinkage at the plastic stage of cooling being greater than the strength of the metal. Fortunately, for many *steel* castings, a "hot-tear" need not always mean it is scrap, and a large proportion can be salvaged by welding.

Surface Depression.—This is the least dangerous form of shrinkage, from the inspector's viewpoint. If the depression be measured and the inspector is certain that

the casting will clean up in machining, or that it will not do any harm if on a surface which is not machined, he should pass it. Where a surface depression is present, the casting underneath is almost invariably solid.

Of course, this type of shrinkage must be reported and corrected, even if castings are not rejected by inspection, for, unfortunately, the next batch may show deeper depressions and produce scrap. Also, another batch may show no surface depression, but may contain an interior shrinkage sufficient to cause scrap. Often a surface depression is not a true shrinkage, but the result of a combination of circumstances, *i.e.*, a "hot spot," with its natural tendency towards shrinkage, plus gas pressure. The actual cavity is formed by gas pressure, the metal immediately underneath, far from showing signs of shrinkage or porosity, often being more dense in structure than other parts of the casting, so long as the pressure exerted is downwards from the top of the mould. When such "gas pressure" cavities are found on the lower part of a casting, they are decidedly more dangerous, as the defects are probably located in higher portions of that section. This is shown in Fig. 13. Where a casting has been sectioned to show gas-holes under the top casting surface, and a large depression, resembling shrinkage, in the bottom surface. As this latter defies the law of gravity, it is obviously due to gas pressure. These defects were caused by the use of a very low-permeability, small-grain-size sand, used with too high a moisture content and probably aggravated by unnecessarily hard ramming for this particular type of sand. Steam, generated by pouring at a high temperature, not finding an easy passage to atmosphere, is trapped in and below the solidifying metal whilst trying to find its way out through the still "pasty" iron.

Porosity.—This is a form of shrinkage which shows no definite sign of its presence on the surface of the casting, but is usually revealed during machining. To keep the number of porous defectives after machining within reasonable limits, close and frequent contact between foundry inspection department and machine shop is essential. The inspector will be able to give precise information to the foundry regarding position, extent and frequency of porosity; the rest is for the foundry to overcome.

Unfortunately, the correction of porosity is often difficult; there are so many possible causes, such as risers insufficiently large nor adequate in number; placed in wrong position, or even non-existent; the presence of a "hot spot"; unsuitable runner position; metal faults in respect to temperature or composition; use of unsuitable grade of metal, or unreasonable variations in section thicknesses due to design, or a "generous" patternmaker. If the laboratory cannot give complete and reliable information regarding metal temperatures and composition, the foundry superintendent's job of correcting porosity cases is made immeasurably more difficult. A casting inspector of some years' experience, who does not develop a genuine respect for the difficulties and troubles which continually harass the foundry foreman, should be promoted to be foundry foreman at the first opportunity.

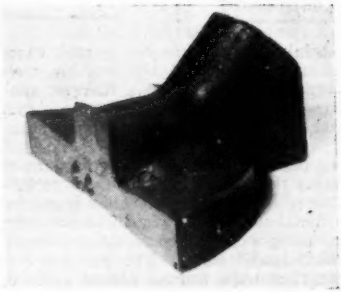


FIG. 13.—CASTING SECTIONED TO SHOW GAS HOLES BELOW THE UPPER SURFACE AND A CAVITY IN THE LOWER SURFACE. (CASTING IS APPROX. 6-IN. DIA.)

Salvage of porous castings can often be effected by use of Bakelite, rusting or liners, but the Author would not advise the use of anything but liners if the surface has to withstand much friction, such as that of a cylinder bore, as the spot of porosity or "loose iron" would probably wear unevenly and let through the oil. When a casting is the subject of experiment with the intention of eliminating porosity, the availability of machine tools in the inspection, or experimental department, is most necessary. The sending of an experimental casting, or castings, through the machine shop in the usual way causes such a time lag between experiment and result that either delay in production or further defectives are almost certain to occur.

Cavity under Riser.—Risers are usually placed on a heavy section of a casting to ensure its being quite solid; therefore, if a cavity is found under a riser, it generally means the casting must be scrapped. The inspector should never assume that the visible cavity is all there is; further cavities, connected or not, often extend to some considerable depth in the casting. This type of cavity, shown in Fig. 12, is caused in most cases by shrinkage, but quite frequently it is due to the presence of gas or to a combination of gas and shrinkage. Whatever the cause, pouring metal into the riser is often a cure.

If the cause of the defect be shrinkage, the surface of the cavity will, in the case of iron, be of a dull matt purple-blue colour, of irregular shape, and often showing "cracks" or dendritic formation. If the cavities be formed by trapped gas, they will be smooth and shining; the only clue to the presence of large gas cavities is often a few small gas-holes in, or near, the neck of the riser. If the inspector does not investigate such signs with the aid of a drill, or other machine, the "returns from customer" percentage will become needlessly high at times. Gas cavities under a riser are in most cases caused by "dead metal," *i.e.*, metal of too low a temperature to expel normal mould gases. When cavities show surface signs of both gas and shrinkage, it is quite easy to be mistaken, and to attribute the

Casting Inspection

trouble to shrinkage. The trouble in such cases is invariably gas, and often this is caused by low metal temperature. In cases of gas and shrinkage, the upper parts of the cavity will be smooth and shining, but rough, "cracked" and dull surface will be seen at the bottom.

The casting conditions of such defectives are often as follow:—Either the riser, especially the "neck," is too small, and the solidification of the riser is quicker than that of the metal underneath, or the same thing may happen when using a riser of correct dimensions in conjunction with "dead" metal. The premature solidification of the riser traps normal mould gases beneath the riser, usually causing a large cavity, or cavities, extending to some considerable depth in the casting. The gas, forcing itself against the solidified riser neck, makes the top of the cavities smooth and shining, but shrinkage of the fluid metal at the bottom of the cavity still has to take place without any help from the riser, and it does so, giving the lower part of the gas cavity every appearance of being a normal shrinkage effect.

Shrinkage, in its various forms, and especially in high-duty irons, is a frequent cause of trouble, and as the reason for it is not easy to trace, the inspector should always be extremely thorough when examining shrinkages, because the resultant information may be of considerable help to the foundry foreman when he is solving the difficult problem of correction of the fault. Cavities under Cameron core risers or shrink bobs may be due to shrinkage, if the percentage of voids in the core is incorrect, or if the metal temperature or composition is lower than standard, but where oil-sand cores are used, the cavities will generally be due to gas from the centre of the core, although, at first glance, shrinkage may appear to be the trouble. To cure this trouble, bricks instead of oil-sand cores or cores made of fireclay may be used.

Wrong Metal Mixture

If the metal poured into a casting, or batch of castings, is unsuitable, they must be scrapped, but not by the casting inspector; all he has to do is record the facts. The onus of scrapping such defectives lies with the metallurgist; the casting inspector may sometimes discover some castings are too hard (by a combination of luck and observation), but he is not expected to analyse metal by looking at it.

Gas Holes Due to Metal Faults

Oxidation of cast iron is not common; in fact, it is practically unheard of where melting is under close control, but obscure troubles, relative to oxidation, can occur on high-grade metals. If oxidation does occur, it should be, and almost certainly would be, discovered by the foreman in charge of the melting, and the metal would be scrapped before it did any harm. If a casting containing oxidised metal should be sent to the inspection department, the trouble can usually be identified by the finding of numerous gas-holes of varying sizes, most probably under a riser, but possibly they may be found anywhere in the casting, after "picking." Gas-holes which are caused by mould or core gases are almost invariably on top of a casting, but gas-holes due to oxidation are almost as likely to be found in the bottom of a casting as anywhere else.

The only reason for gas-holes due to metal faults which is likely to exist in the average foundry is that the pouring temperature is too low. Fig. 14 (*a*) shows the top of a casting after the inspection pick had been

FIG. 14.—(*a*) CASTING SHOWING GAS HOLES (ORIGINALLY UNDER THE TOP SURFACE);

(*b*) SAME CASTING: UNDERSIDE, SHOWING SMOOTH SKIN (CASTING IS APPROX. 8-IN. DIA.).

FIG. 15.—MACHINE-MOULDED CASTING EXHIBITING A BAD SKIN—DUE TO USE OF WRONG MOULDING SAND.

used on it. Although the "skin" of the casting was originally unbroken by any gas-holes, the smooth, shining surface and its colour made it evident that gas-holes were present under the "skin." Such defectives as this are, of course, rejected during primary casting inspection, to avoid wastage of fettling time. The faults were due to pouring metal at too low a temperature into a mould made of low-permeability sand, which had been mixed for producing a high-quality surface finish. The mould was not sufficiently vented to allow easy escape of the normal amount of gas from a mould of this type of sand. The gases were trapped beneath a skin of metal on the top face of the casting. Fig. 14 (*b*) shows the bottom of the same casting, which proves that the sand used would certainly produce a really fine skin on a green-sand casting. This is of little use unless the other casting conditions are under close control. This form of scrap is related to "misrun," but whereas the "misrun" defect commonly affects only thin sections, gas-holes due to "dead metal" are just as likely in thick sections as in thin, and may be found at some considerable distance down from the top surface of the casting.

When gas is trapped in a casting by low-temperature pouring, cavities may be large in number or size, and often contain smooth lumps of metal resembling pebbles. Many cavities cannot be reached by a pick if they are deep down in a heavy section. The only place for such castings is the scrap pile; attempts at salvage by welding may sometimes appear feasible, but are nearly always a waste of time. The inspector should never record the verdict "gas-holes due to metal" without first consulting the foundry foreman and metallurgist—it is easy to be mistaken in such cases.

Sand Faults

If a constant check of all mould and core sands is routine in a foundry, this type of trouble is not likely to occur to any noticeable extent. About the only way in which the casting inspector can discover the presence of sand faults is by noticing numbers of different castings suffering from the same type of defect, such as scabs on cores or moulds, or certain types of gas-holes. If the inspector should notice a series of defects which makes him think the sand may be at fault, he should report the matter at once; if unsuitable sand is used in the foundry, both the foundry foreman and the inspector will be very busy, until the fault is corrected. Sand faults can, and will, cause prolific scrap, and every possible primary precaution should be taken to prevent them (see Figs. 13 to 15). Fig. 15 shows a light machine-moulded casting, rejected due to bad skin finish. The moulding sand, intended for other purposes, was used on the moulding machine by mistake. The causes of the defect are incorrect sand properties, *i.e.*, high green-bond strength and large grain size base sand, giving low flowability on the jolt-ramming moulding machine, resulting in badly rammed moulds and an extremely rough surface on the casting. In this case the details of the sand faults were checked and made available, at the request of the Author, by the foreman in charge of sand testing; they are not merely opinions formed by the Author.

(*To be continued.*)

Publications Received

City of Birmingham, What to See; What to Do; Where to Stay. Published by the Information Dept., Council House, Birmingham, 1.

A prominent foundryman once stated publicly that he had found it impossible to drive his car from the centre of Birmingham to Coventry owing to the maze of one-way streets. A study of this folder, which includes a map of the central area, clearly shows this to be an exaggeration. The reviewer suggests that the foundryman in question and all others who from time to time visit Birmingham should arm themselves with this folder, which will be sent to them free of charge, if they mention the JOURNAL in writing to the Council House.

Films about Metals, compiled by the Scientific Film Association and the Joint Committee on Metallurgical Education. Published by Current Affairs, Limited, 19, Charing Cross Road, London, W.C.2. Price 3s. 6d.

The Joint Committee on Metallurgical Education referred to as sponsoring this compilation is drawn from the Iron and Steel Institute; the Institution of Mining and Metallurgy; the Institute of British Foundrymen; the Institute of Metals, and the Institution of Metallurgists. The result has been the listing of all the films likely to interest members of these bodies. This has been particularly well done and the local sections of these institutes would do well to procure a copy of this booklet as an aid for programme building. Useful technical information is given as to the physical character of each film listed, together with a note as to the field covered.

THE SPRING MEETING of the Institute of Welding will be held at the Beach Hotel, Southsea, from April 26 to 29. The programme includes visits to foundries at Eastleigh Locomotive Works and John I. Thornycroft and Company, Limited.

Wrong Metal Causes Scrap

By "Coroner"

When a casting, which has been produced regularly for a period without there being any appreciable scrap, suddenly turns out to be defective, it is evident that something different has been done to account for the wasters. Often many days pass before the defect is discovered, and it is then difficult for the foundry executives to recall any untoward circumstances which may account for the failure.

Such a case recently came to the writer's notice. A fairly "lumpy" Vee-belt pulley of approximately two feet diameter was being cast successfully in a certain mixture which was usually poured about midway through a cast of some 10 tons or so. The earlier metal was of a better grade and was used for high-class machinery components of fairly thin section, which consequently demanded hot, fluid iron to run successfully. Occasionally, this metal was not considered by the foundry foreman to be sufficiently hot for these jobs and was thus used for some other castings which did not require to be machined. After a certain amount of inquiry the cause of the trouble in this particular batch of castings was found to be due to the foreman using in these Vee-pulleys the higher-class metal, which was not hot enough to run the light-section castings. His reason was that, in his opinion, the metal would be hot enough to run these heavier jobs and that this was a good way of using it.

Unfortunately, he did not realise the cause of the lack of fluidity in the metal, which was apparently slightly oxidised, for, on cutting one of these pulleys which exhibited an "airy" patch on the top face, one portion of the interior was found to be a cluster of pellets just like a bunch of grapes.

The lesson from this experience is—never try to use up dull metal, even of high quality, in a job which has to be extensively machined, as it is almost certain to be defective no matter how heavy it may be. Better to pour the metal into ingots for remelting than run the risk of a costly waster.

A New Aluminium Paint

The Atlas Preservative Company, Limited, of Fraser Road, Erith, Kent, have for many years specialised in the production of protective coatings for application to foundry buildings and plant. The latest development, which is covered by Provisional Patent No. 33175/48, is a high-temperature resisting aluminium paint. It is claimed that it will withstand 600 deg. C. without disruption of the film, and so is very useful for treating furnace doors. It has good spreading properties, and one concern recently visited by our representative had "spring cleaned" the whole foundry on 2 gallons. The normal consumption is stated to be 800 sq. ft. per gallon.

MR. JACK JONES, Joint Parliamentary Secretary, Ministry of Supply, is to open the Foundry Foremen's Training Course which is being held at Ashorne Hill, during the week-end starting on Thursday, April 21.

Power for Ventilation

There was recently carried out on our behalf a statistical study of the power used for ventilation and dust extraction by ironfoundries. The report we have received give the figures as ranging between 7 and 45 per cent. Two well-managed foundries consume about 10 per cent. Where heavy castings are made, the percentage is obviously lower. Our objects in collecting these figures were:—(1) Since much capital outlay will be expended on ventilation and dust extraction during the next decade, it appears to us, that this cost will constitute a heavy continuous charge against production, and too much care cannot therefore be given to the choice of efficient plant and its correct disposition in the foundry. (2) We want to establish the order of ventilation requirements for various sorts of foundries.

To enable us to continue our studies, we should appreciate receiving from readers the figure for the percentage of power they use which is devoted to dust extraction and ventilation.

Light Castings Wages

Wage increases of 5s. per week for male workers engaged in the Scottish light iron castings industry was announced on April 8. Women will receive 4s. a week and there will be proportionate increases for junior workers. Mr. William M'Guinness, National Union of General & Municipal Workers, stated that the increase had been awarded by the National Arbitration Tribunal. It means that labourers will receive 95s. for a 44-hour week, which is 3s. more than the weekly rate for engineers' labourers. Most of the light iron castings industry in Scotland is situated around Falkirk.

61 Years' Service

Mr. Alex Stewart, director and secretary of M. Cockburn & Company, Limited, Falkirk, was guest of honour last week at a complimentary dinner given by the firm on his retirement after 61 years' service. Mr. R. L. Hunter, managing director, presided, and apologised for the absence of Mr. W. H. Smith, deputy chairman of Allied Ironfounders. Letters of appreciation were read from R. G. Hunter, former director of the firm; and from Mr. H. E. Bethell and Mr. H. K. Winter, of the sales staff. Mr. Hunter made a presentation on behalf of the management.

KODAK, LIMITED, recently celebrated the 21st anniversary of the establishment of their laboratories by the holding of a two-day conversazione at which many eminent scientists were the guests of Mr. E. R. Davies, C.B.E., the research director.

AT THE THIRD annual post-war dinner and dance given by the management to employees of Lane & Girvan, Limited, Bonnybridge, which was held in the Public Hall. Mr. James Ferguson announced that plans were under way for enlarged spray baths, a canteen and other amenities.

The National Foundry College, First Report

Preliminary Statement

In September, 1939, the Governors of the former British Foundry School decided to suspend the activities of that School in view of the war emergency. The Head of the British Foundry School had previously indicated his intention of accepting a responsible post in the foundry industry.

When hostilities ended, many discussions, in which leaders of the industry and officers of the Ministry of Education took part, made clear the wish of the industry that the activities of the British Foundry School should be resumed in some suitable form. The publication in July, 1945, of the report of the Departmental Committee on Higher Technological Education, and the issue by the Ministry of Education in April, 1946, of their Circular 98, clearly determined the conditions in which such a revival might most easily take place.

It was in due course agreed by the Ministry of Education and the Joint Education Committee governing the Wolverhampton and Staffordshire Technical College, with the concurrence of the leading associations and institutions of the foundry industry, that accommodation for the National Foundry College should be provided by the Wolverhampton and Staffordshire Technical College.

Accordingly, on July 17, 1947, there met at the Wolverhampton and Staffordshire Technical College a Board of Governors appointed by the Minister of Education, under Mr. Randall G. Hosking, as Chairman, who, after due consideration, empowered their Chairman to execute a Declaration of Trust, setting up the National Foundry College and providing for it to operate within the Wolverhampton and Staffordshire Technical College. Under this Trust Deed, Dr. Fisher was appointed Director of the National Foundry College, and as such is required to submit annual reports, of which this is the first.

Report

In due course, on the recommendation of the Board of Governors, the Minister of Education appointed Mr. James Bamford, B.Sc., M.I.B.F., to be Head of the National Foundry College. He took up his duties on December 1, 1947. The Head of the College has drafted the main part of this report. The reporter takes the opportunity of paying tribute to the success with which Mr. Bamford has combined an entire devotion to the efficient conduct and successful development of the National Foundry College with consideration for the students and staff of the parent college, and with readiness to co-operate with the Departments of Engineering and Applied Science. Subsequently, Mr. J. B. McIntyre, B.Sc., A.I.M., was appointed as Assistant, and took up duty on April 19, 1948. Other appointments have been authorised but have not yet become effective.

Certain rooms within the Wolverhampton and Staffordshire Technical College were put at the full disposal of the National Foundry College. In addition, Foundry College students enjoy all the facilities available to local students of the Wolverhampton College, such as the library, the gymnasium, the refectory, the common room, etc.; they are also eligible for membership of college societies and sports club. For this accommodation the National Foundry College will pay a rental, computed by assigning to them a fraction of the annual expenditure of the Wolverhampton and Staffordshire Technical College under headings which do not appear separately in the estimates of the National Foundry College. The fraction is decided by the ratio which the floor area assigned to the National Foundry College bears to the total floor area available in rooms used for teaching within the buildings.

The Trust Deed charges the Governors with wide responsibilities for the provision of technical education and research in connection with the Foundry Industry. As a matter of expediency the Governors decided that their first task should be to offer a single-session post-graduate full-time Diploma Course, corresponding to the Diploma Course of the former British Foundry School. Actually, since the Head of the College could not take up duty until December, 1947, the course arranged was of an intensive character, the attendance of students being from January 5 to August 18, 1948.

Eighteen students enrolled for this first course, having an average age of about twenty-five. Eleven of them were nominated and supported by their employers, including one student from Ceylon, and another from Egypt. The remainder made independent applications, one attended the course with a Fellowship of the Worshipful Company of Founders and others received aid under the Further Education and Training Scheme. All students came with suitable technical qualifications, two being graduates. It may be mentioned here that at the end of the session two of them were successful in obtaining Fellowships of the Worshipful Company of Founders and are now using them to obtain further industrial experience.

Timetable of Course

For the thirty-two weeks of this intensive course, the students attended for thirty-five hours per week, and, in addition, were required to do a considerable amount of work in their own time.

Associate Lecturers

After the first four weeks of the session, an average of three lectures per week were delivered by specialists, drawn from the industry itself, from research associations and from other institutions. About eighty lectures were given during the session by fifty-three such specialists.

Visits

The students paid weekly visits to foundries and allied works within a radius of about forty miles; during the session twenty-nine firms were visited. Since distance prevented the inclusion of foundries of all types within the normal programme, the session was concluded with a week's visit to Sheffield and the North-east coast. During this week, nine plants were visited. The thanks of the Governors for facilities and hospitality offered to students have been recorded and conveyed to the firms concerned.

National Foundry College, First Report

Technical College Staff

Assistance with lectures and laboratory classes has been given by several members of the Technical College staff, whose willing co-operation in the work is gratefully acknowledged by the Head of the Foundry College. The Governors are meeting the charges made by the Technical College in respect of the teacher-hours involved.

Diploma Examination

The Diploma Examination included the following subjects:—Foundry Metallurgy (two papers); Foundry Technology; Foundry Management; Ferrous Project, and Non-Ferrous Project. The written papers (Metallurgy, Technology and Management) were each of three hours' duration. For the Ferrous Project twelve hours was allowed, and for the Non-Ferrous Project nine hours.

Assessors

The following acted as Assessors in the preparation and marking of the papers:—

Foundry Metallurgy, Foundry Technology and Foundry Management:—Dr. J. G. Pearce (Director, B.C.I.R.A.), G. L. Bailey, Esq., M.Sc., F.I.M. (Director, B.N.F.M.R.A.)

Ferrous Project:—Mr. R. C. Shepherd (Lincoln).

Non-Ferrous Project:—Mr. A. J. Murphy, M.Sc., F.I.M. (London).

Pass List

The following Pass List has been prepared by the Head of the College, in consultation with the Honorary Technical Adviser (who also acted as an Assessor), the Assessor of the Ministry of Education, and the Director of the College:—J. A. Armstrong (Distinction in Non-Ferrous Project); J. A. Ballard; W. J. Campbell (Distinction in Foundry Management); A. M. I. Elzayat; J. Green; P. A. Green; G. L. Harrison; J. R. B. Lloyd, B.A. (Distinction in Foundry Management); F. R. Martin; P. C. Packham, B.Sc. (Distinction in Foundry Metallurgy); P. W. Ryder; F. S. Smith; G. A. D. I. T. Seneviratne; L. E. Stuffins; A. R. Sym, and E. M. Wood. With the adoption by the Governors of this report, the Diploma of the National Foundry College is conferred upon the students named in the Pass List.

Local Activities

The Trust Deed provides for the National Foundry College to undertake regional and local activities, the costs of which are to be met by the Local Education Authorities. The Head of the College has, in fact, undertaken the supervision of certain well-established local courses, which seem likely to develop rapidly under his guidance. The costs of these courses have, however, continued to be met directly by the Governors of the Wolverhampton and Staffordshire Technical College, who are meeting a charge made by the Governors of the National Foundry College in respect of teacher-hours devoted to local courses by members of its teaching staff.

Tor Lodge

From the inception of the proposal that the new Foundry College should be established in Wolverhampton, the Local Authority has been desirous of doing everything possible to assist its establishment, and, more particularly, to ensure that residential accommodation should be available for its students as early as possible in order that their stay in Wolverhampton might be under pleasant conditions. Accordingly, the Authority acquired "Tor Lodge," a country house some three miles from the College and the town centre, in an area served by two alternative local transport service bus routes, and set amidst attractive surroundings with delightful prospect. This is now being adapted and extended to provide accommodation for a Warden and twenty-six students so that they may enjoy the best residential, social and recreative amenities. It is hoped that the Hostel will be available early in the new session. The Governors of the National Foundry College have recorded their high appreciation of the extremely helpful action of the Local Education Authority.

Two-Part Diploma Course

The Governors have decided that, in future, the one-year Diploma Course shall be superseded by a Two-Part Course, the second part of which will be approximately equal to the former one-year course. This will enable candidates deficient in certain ancillary subjects to receive additional training, and will, it is expected, considerably increase the number of fully-qualified entrants to the final year. Entries will ordinarily be to Part I. In exceptional circumstances, however, candidates highly qualified, both technically and industrially, may be admitted directly to Part II of the Course. The first Part I Diploma Course will open on January 3, 1949, to be followed by the first Part II in September, 1949. The last of the one-year Diploma Courses opened on September 27, 1948, and will continue until July, 1949. These changes in the Diploma Course are explained in detail in the recently published Prospectus of the National Foundry College.

Fee Remissions and Aid to Students

Fees were remitted to nine of the eighteen students of the first Diploma Course in view of their nomination by firms giving support to the National College through industrial associations. The Governors have decided to continue the remission of tuition fees on such grounds, and have, in addition, instituted a scheme of aids to independent students. Under this scheme a limited number of independent students may obtain entry scholarships covering tuition fees, residence in the College hostel, and a maintenance allowance, tenable in that part of the Course for which the candidate is eligible. Progress scholarships carrying similar benefits are also made available, and may be tenable in the College by students undertaking post-Diploma work. Full particulars are published in the Prospectus of the College. The Director and Head of the College desire to record their high appreciation of the advice, encouragement and unstinting support given to them during this first session of the National Foundry College by the officers of the Ministry of Education, by the Governors as a body, and in their individual capacities by the Chairman, Vice-Chairman, Clerk and Honorary Technical Adviser.

The Report is signed by Dr. W. E. Fisher, the Director of the National Foundry College.

Personal

MR. LEO EDWARD RICKETTS has been elected a director of Coley Metals, Limited, Hounslow, Middlesex.

MR. L. P. O'BRIEN has been elected chairman of the Fullers' Earth Union, Limited, in place of the late Sir Bertram T. Rumble.

MR. G. F. MANSBRIDGE has retired from the board of the Dubilier Condenser Company (1925), Limited, North Acton, London, W.3.

MR. H. PEARSON LOBNITZ has been appointed a director of the Fairfield Shipbuilding & Engineering Company, Limited, Glasgow.

MR. FRED CROSLAND has been appointed an additional director of Hunt & Moscrop, Limited, bleachers' engineers, etc., of Manchester.

MR. DOUGLAS JOYCE, blast-furnace manager with the Consett Iron Company, Limited, is leaving to take up an appointment with the Algoma Steel Corporation, Ontario.

MR. N. G. LANCASTER has relinquished his partnership with Howard Smith, Thompson & Company, chartered accountants, on his election as a director of Tube Investments, Limited.

MR. T. R. WALKER has been re-elected president and MR. H. S. W. BRITTAIN, MR. J. GUNSTONE, MR. H. LETHERLAND and MR. G. OFFILER, vice-presidents, of the Sheffield Foundry Trade Technical Society.

MR. JAMES TAYLOR has resigned from the board of Buckley & Taylor, Limited engineers and ironfounders, of Oldham, while MR. T. J. MAKIN, MR. E. HALLAS and MR. W. UDALL have been appointed directors.

MR. T. W. GUTHRIE, of 33, Pembroke Crescent, Hove, 3, has been appointed technical representative for London and the South-East for F. E. Rowland & Company, Limited, manufacturers of grinding machines, etc., of Reddish, near Stockport.

MR. J. L. BOTWRIGHT, engine works manager with William Doxford & Sons, Limited, Sunderland, has been awarded the Constantine medal by the Manchester Association of Engineers for the best engineering Paper submitted during the 1947-48 session.

MR. JOSEPH JAMES, works engineer of the North Eastern Marine Engineering Company (1938), Limited, Wallsend-onTyne, for 40 years, retired on April 1. He was awarded the B.E.M. for his efforts to keep the company in full production during the 1939-45 war.

MR. J. WILLIS BROWN, who recently resigned from the position of managing director of the Lilleshall Company, Limited, has received presentations to mark the occasion. MR. HERBERT KENWORTHY, who is retiring after being associated with the company since 1887, has also received a presentation.

DR. C. DANNATT, chief electrical engineer and a director of Metropolitan-Vickers Electrical Company, Limited, has been appointed a member of the Mechanical Engineering Research Board of the Department of Scientific and Industrial Research in place of the late Mr. D. E. Hoseason.

MR. HUGH PERRY has been appointed a director of Smith's Stamping Works (Coventry), Limited, and of Smith Clayton Forge, Limited, Lincoln. He was until recently sales manager of Almin, Limited, Farnham Royal, Bucks, and a director of its associate companies, Renfrew Foundries, Limited, Glasgow, Southern Forge, Limited, Langley, and the Warwick Production Company, Limited, Warwick.

MR. JAMES FERGUSON has been appointed to the new post of staff inspector for technical education which has been created in the Scottish Education Department; his responsibilities will extend to the whole of Scotland. Mr. Ferguson, who is at present one of H.M. Inspectors on the general staff of the Western Division, had practical engineering experience with Babcock & Wilcox, Limited, engineers, boilermakers, etc., of Renfrew, before joining the Department.

MR. E. G. WEDDELL, who has been associated with W. G. Allen & Sons (Tipton), Limited, colliery engineers, steel fabricators, etc., for many years as sales director, has now reached the retiring age, and his place on the board has been taken by MR. ARTHUR DYSON, who also becomes vice-chairman of the company. Mr. Dyson is a director of Horseley Bridge & Thomas Piggott, Limited, Tipton, and a past-president of the Institute of Welding. MR. ALBERT WEDDELL, who has recently completed 50 years in industry and has been connected with the company since 1915, at his own wish, relinquishes the joint managing directorship of the company, which position he has held jointly with his elder son—MR. R. E. G. WEDDELL—for some years, but remains chairman of the board. MR. J. H. PLANT, secretary of the company and who has been a director for some years, has been appointed joint managing director, with MR. R. E. G. WEDDELL. MR. D. A. G. WEDDELL, younger son of Mr. Albert Weddell, joins the board of the company, retaining his position as manager of its London office.

Wills

MANNOX, F. C., managing director of Murex, Limited, Rainham, Essex £6,276

HOWIE, HUGH, proprietor of John Booth & Sons, ironfounders, etc., of Ripponden, Yorks £3,725

KNOTT, MRS. B. A., a director of Muxlow & Knott, Limited, steel manufacturers, of Sheffield £7,304

HAWTHORNE, W. E., a director and secretary of Cannon Iron Foundries, Limited, Bilston, Staffs £74,027

PAIRMAN, R. H., late secretary of the Scottish Boiler & General Insurance Company, Limited, Glasgow £11,494

PEART, F. W., managing director of Heeley & Peart, Limited, malleable-iron founders, of Newport, Mon £38,900

URRY, W. O. J., a director of Heenan & Froude, Limited, structural engineers and ironfounders, of Worcester £12,324

SMITH, CHARLES, former shipyard manager of the Caledon Shipbuilding & Engineering Company, Limited, Dundee £4,136

REED, WILLIAM, a director of Smith's Dock Company, Limited, Middlesbrough, and of the Tyne Metal Company, Limited £66,332

WATERHOUSE, ARTHUR, managing director of John Bedford & Sons, Limited, steel and tool manufacturers, of Sheffield £6,712

COTTS, JOHN, a partner and former managing director of William Cotts & Sons, Limited, iron and steel forgers, of Sanquhar £6,505

HOWIE, ROBERT, proprietor of Robert Howie & Company, ironfounders and railway-chair manufacturers, of Kilwinning, Ayrshire £14,142

WIMSHURST, J. E., consulting engineer, of Southampton, a member of the Institute of Marine Engineers and the Institution of Naval Architects £3,860

Parliamentary

Non-ferrous Metals Production

MR. DOUGLAS MARSHALL asked the Minister of Supply what were the names of his principal advisers, both full-time and part-time, on matters relating to the production of non-ferrous metals in the United Kingdom, and what was the approximate division of duties between the several officers and consultants.

In reply, MR. STRAUSS said that it had recently been decided that arrangements should be made for his department to take over general responsibility for the production of non-ferrous metals in the United Kingdom, except the inspection of health, safety and welfare measures. The division of responsibility between departments had not yet been closely defined and no advisers had been appointed.

MR. MARSHALL: "Will the Minister see to it, when he does appoint these advisers, that among them are some who are technical experts in Cornish tin mining?"

MR. STRAUSS: "The hon. Member may be sure that I shall appoint people who will be best equipped for the job."

MR. W. ROSS, who asked the Minister of Supply what representations he had received about redundancy in the Glacier Metal Factory, Kilmarnock, and what action he had or was proposing to take, was told by MR. STRAUSS that he had recently received a copy of a resolution passed by the workers and workers' representatives employed at the factory, but he regretted that his department was not in a position to control the placing of commercial orders in order to maintain employment at individual factories.

THE MINISTER OF SUPPLY told Mr. Lambert that additional plant for the production of steel water tubes had recently been installed and was now operating, while the Minister of Works had informed him that the capacity to produce asbestos pipes was being fully used, but production was insufficient to meet both home and export requirements. An increase in manufacturing capacity would not at present improve the supply of pipes except at the expense of other asbestos and asbestos-cement goods, owing to the shortage of asbestos fibre.

Control Extended over "War" Goods Exports

The President of the Board of Trade has made an Order which became operative on Friday extending export licensing control over a wider range of goods of potential military value. The goods concerned include specified non-ferrous metals and alloys, high-speed compressors, diamond dies, diamond tipped tools, certain metal-working machines, various chemicals, metal in some forms for special purposes, and unmounted diamonds (other than cut and polished gems), and diamond powder.

With certain exceptions the items are, however, exempt from licensing procedure if exported to the British Commonwealth, O.E.E.C. countries, or the United States.

Development of Technical Education

Government's Plans Outlined

Speaking on the development of technical education on a comprehensive basis on April 4, Mr. George Tomlinson, Minister of Education, said the Government recognised how important it was that those engaged in technical education should have the proper tools. Between now and 1952 it was intended to carry out a building programme which should meet all existing and foreseeable needs.

"A national advisory council has surveyed the whole field. Regional councils and academic boards have been working for some time to link up the major technical colleges with each other and with industry. We now have the machinery for the whole country, which will avoid overlapping of courses and duplication of effort."

Mr. Tomlinson said he believed the future of technical education was a bright one. The demand from industry, and from the individual, was now greater than ever before in our history. About 250,000 students were now being released for daytime training by their employers, compared with 170,000 in 1947 and 40,000 in 1938. He also said that he was instituting a national scheme to provide training in management.

Public Admission to the B.I.F.

At the forthcoming British Industries Fair, to be held from May 2 to 13, new arrangements have been made for public admission at the Castle Bromwich section. To avoid overcrowding of the exhibition building while buyers are touring the stands, admission times for the general public will be from 2 p.m. to 6 p.m. daily (May 2-6 and May 8-12), all day on Saturday, May 7, and from 2 p.m. to 4 p.m. on the last day of the Fair. The price of admission will be 2s. 6d. A new system, whereby the public was restricted to admission on three whole days, was introduced at the London sections of the Fair (Earls Court and Olympia) last year. This was found to be of benefit to buyers, and the arrangement will continue this year. The London sections will be open to the public all day on May 4, 7 and 11. The price of admission will be 1s. 6d. in each case.

The heavy engineering section of the Fair at Castle Bromwich is this year larger than ever before and work has commenced on its preparation. More than 800 tons of machinery will be put down in the next few weeks. Over 413,000 sq. ft. of actual stand space at Castle Bromwich will be occupied by 1,161 exhibitors. The space occupied is 13,000 sq. ft. above last year's total, which was the previous highest. The number of exhibitors is 40 more than last year.

THE ADDRESS of the Ministry of Supply Machine Tools Disposal Headquarters is now Great Westminster House, Horseferry Road, London, S.W.1 (telephone: Victoria 3811); inquiries for the London Disposal Centre should be made to Room 623.

News in Brief

BRITISH ENGINES, LIMITED, is to build a new foundry at Glasshouse Street, Newcastle-upon-Tyne.

ALLAN KENNEDY & COMPANY, LIMITED, light structural engineers, of Stockton-on-Tees, has celebrated its silver jubilee.

GOODBRAND & COMPANY, LIMITED, has had plans approved for extensions to its foundry at Whitelands Road, Ashton-under-Lyne.

JULY 10 NEXT marks the 50th anniversary of the incorporation of the Metropolitan-Vickers Electrical Company, Limited, as the British Westinghouse Electric & Manufacturing Company, Limited.

INCANDESCENT HEAT COMPANY, LIMITED, Smethwick, has obtained a £70,000 contract to supply equipment to the locomotive sheds of the Tata Locomotive & Engineering Company, Limited, Jamshedpur, India.

DOXFORD OIL ENGINES are to be built under licence in Norway at the Rosenberg shipyard, Stavanger. This is the seventh foreign country with a licence to build the Doxford engine. Production will not begin, it is stated, for about two years.

NEWCASTLE-UNDER-LYME CORPORATION Town Planning Committee has approved, subject to other consent being forthcoming, that a site of approximately 2 acres be sold to J. T. Price & Company, Limited, Stourbridge, Worcs, for the erection of a foundry.

EMPLOYEES OF T. & C. Clark & Company, Limited, chemical-plant manufacturers, etc., of Wolverhampton, recently received a delayed gift in celebration of the company's 150th anniversary. The firm was founded in 1795. Each employee received £1 for each year of service with the company.

AN UNOFFICIAL STRIKE which had lasted six weeks at the new giant unloading plant of Dorman, Long & Company, Limited, at Grangetown, ended on March 29. The following day a further stoppage of two hours occurred. In each case the dispute arose over the manning of the plant.

A NEW MACHINE SHOP at the works of the Mining Engineering Company, Limited, Worcester, was officially opened on April 4 by Mr. M. F. Higgins, chairman and managing director of the company, who said that since 1925 the works had been enlarged to 12 times their original size.

DONCASTER CORPORATION WATER COMMITTEE recommends the acceptance of the tenders of the Staveley Iron & Chemical Company, Limited, Chesterfield, and the Stanton Ironworks Company, Limited, Nottingham, for the supply of cast-iron pipes and special castings during the year ending March 31, 1950.

OFFICE STAFF AND WORKERS of the Portdownie Iron Works of Walker, Hunter & Company, Limited, Falkirk, were entertained at dinner on the occasion of the jubilee of the firm as a limited company. Some 200 people sat down to dinner under the chairmanship of Mr. J. G. Cunningham, chairman of the firm.

AN 80-TON ROLL HOUSING, part of a complete aluminium strip mill, left the works of Davy & United Engineering Company, Limited, Sheffield, recently, on a 4½-day journey by road to the Northern Aluminium Company, Limited, Newport, Mon. Three more journeys will be made to transport the entire two-stand mill.

THE DIRECTORS of the Glacier Metal Company, Limited, have decided not to proceed with the proposed issue of 303,200 ordinary shares of 5s. each which were to have been offered to ordinary stockholders. The new issue is postponed until the full implications of a recent patents judgment can be determined.

NEW ISSUES OF CAPITAL in Australia and South Africa are to be made by International Combustion, Limited, to finance the construction of works which will relieve the pressure on the Derby works. In Sydney, 200,000 5 per cent. preference shares will be issued, and in Johannesburg, 150,000 5½ per cent. £1 preference shares.

THE PRESIDENT OF THE BOARD OF TRADE (Mr. Harold Wilson) is to visit Canada next month to study at first hand the problems of expanding our exports to this market. He had intended to visit Canada before but was unable to do so. He will be present at the opening of the Canadian International Trade Fair at Toronto on May 30.

THE GROUP now employed some 35,000 workpeople, but still needed 5,000 more, said Sir George H. Nelson, chairman of the English Electric Company, Limited, in his speech at the company's recent annual meeting. Because the company could not obtain the required labour only about 77 per cent. of its manufacturing facilities, now practically complete, was in use.

FOLLOWING THE STATEMENT made by the President of the Board of Trade on relaxations of controls on March 22, the Board of Trade announces that the control of the allocation of white lead and titanium oxide has ceased from April 1. Ordinary trading conditions are now established, and applications for white lead and titanium oxide should be made direct to the suppliers.

THE MINISTRY OF SUPPLY is arranging for small quantities of slightly radioactive waste material from the Atomic Energy Research Establishment to be disposed of by dumping in the deep waters of the Atlantic Ocean during the spring and summer of this year. The total quantity of radioactivity which will be disposed of in these operations is much too small to have any harmful effects on fish or human life.

"PRODUCTIVITY PAYS" is the title of a booklet which has been prepared, for free distribution throughout the country, by the Economic Information Unit and the Central Office of Information. It is the first booklet to set out the case for productivity in personal and proper terms. Copies may be had, post free, on application to:—Economic Information Unit (Room 651), Norgeby House, 81, Baker Street, London, W.1.

MR. R. A. ABDUNNER, P.O. Box 868, Beirut, wishes to obtain the agency for a United Kingdom firm manufacturing horizontal Diesel engines. Interested com-

panies should communicate with Mr. Abdunner direct, at the same time notifying the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1 (reference, C.R.E. (I.B.) 4458/49), of any action taken.

PAUL & GRAY (PTY.), LIMITED, 82, Sussex Street, Sydney, Australia, wishes to represent a United Kingdom firm manufacturing Diesel engines of from 10 to 100 h.p. Interested companies should communicate with the firm direct, at the same time notifying the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1 (reference, C.R.E. (I.B.) 7732/49), of any action taken.

THE POWER-GAS CORPORATION, LIMITED, and Ashmore, Benson, Pease & Company, Limited, have acquired the lease of the new North-East Trading Estates factory in Bowesfield Lane, Stockton-on-Tees. The factory will be specially equipped for the production of heat exchangers, industrial fume and dust control and recovery plant, etc. It has a workshop floor area of about 20,000 sq. ft. and is designed for ultimate expansion to 60,000 sq. ft.

IT IS UNDERSTOOD that the Iron and Steel Trades Employers' Association will give a considered reply on May 4 to a wage claim submitted on behalf of key workers in the industry to a joint meeting in London on April 6 of representatives of the employers and the unions. The men are seeking a new national wages structure under which the same minimum rate would be paid for similar work throughout Britain. Increases varying from 15s. a week on the North-East Coast to 30s.-35s. in Scotland are involved.

AS PART OF ITS POLICY to assist in the resettlement in civil life of ex-Service regular personnel, the Government has made arrangements for the starting of courses of business training towards the end of April. The training will consist of a three-month theoretical course at a technical college, followed normally by practical training in a firm for three to six months. Ex-Regulars who left the Forces on or after July 1, 1948, will be eligible to apply. Particulars of the scheme are contained in Leaflet P.L.309, obtainable from appointments offices of the Ministry of Labour.

MR. ROBERT WILSON, speaking at a dinner-dance given by the management to employees of Lane & Girvan, Limited, Bonnybridge, referred to the great skill which was exhibited in the light-castings industry, but which, he said, sometimes did not get its due prominence either from the public or from the workpeople themselves. He felt that there was a good deal of traditional skill in the trade and thought that all concerned should take the utmost pride in the work they turned out. Mr. James Ferguson, a director, who presided, spoke of plans which were under way for enlarged spray baths, a canteen, and other amenities.

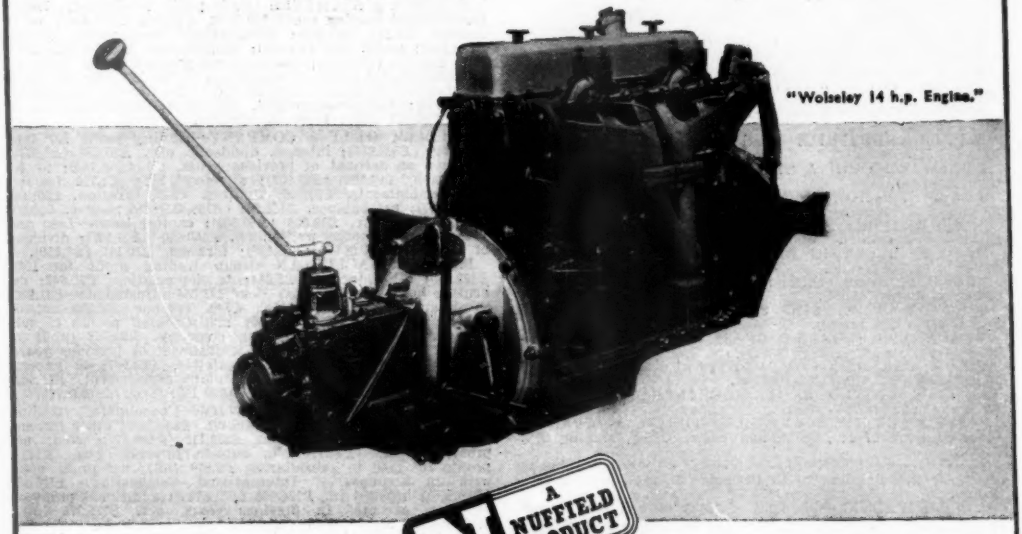
ADDRESSING MEMBERS of the Royal Scottish Society of Arts recently on the work of the Department of Scientific and Industrial Research, Dr. H. Buckley, who is in charge of the Scottish office of the department, said that the National Mechanical Engineering Research Laboratory, which was being established in Scotland with an eventual annual expenditure of the order of £300,000, would be second only to the National Physical Laboratory (the largest of the 14 national research laboratories operated by the department). He added that branches of the department's building, road, and fuel research laboratories would shortly be in operation in Scotland.

H. & E. LINTOTT, LIMITED, engineers and ironfounders, of Horsham, Sussex, recently organised a dinner to celebrate 500 years of service by 15 employees, nine of whom work in the foundry and pattern-shop. Mr. Frank Gibbs, 65-year-old patternmaker with over half a century of service to his credit, was presented with a gold watch by the managing director, Mr. Frank H. Ayling, and the 14 others, whose services range from 25 to 37 years, were each the recipient of a silver watch. Among the guests of honour were Lady Winterton (who apologised for the absence of Earl Winterton due to Parliamentary duties) and Mr. F. P. S. Stammers, co-director to Mr. Ayling.

THE YEAR 1948 was a record in the 12 years' history of the company, said Mr. John S. Tropman, chairman, at the annual meeting of Westwood, Dawes & Company, Limited, mechanical and structural engineers, etc., of Stourbridge, Worcs, on March 29. He said that the turnover exceeded that of 1947 by nearly 30 per cent., and the rate of gross profit showed a small reduction, indicating that the company had passed on some of the benefit of increased production to its workpeople and customers. Mr. Tropman said that additional plant had been installed in the new shop and the output of conveyor rollers had increased. The company had a good order-book and production was satisfactory.

A SCHEME IS to be put in hand to increase the width of the Graythorp dock entrance of William Gray & Company, Limited, shipbuilders, of West Hartlepool, from 150 ft. to 400 ft., and to double the berthing accommodation. The excavations will be carried out with open-cast machinery bought from the N.C.B. The cost of the scheme, it is estimated, will be roughly half the cost of the dredging operations which are periodically necessary to maintain sufficient depth of water in the existing harbour; the machinery, which can be operated by three men, will dig the new harbour without interfering with the current use of the dock and repair yards. It is expected that the work will take from 18 months to two years to complete.

HEENAN & FROUDE, LIMITED, structural and manufacturing engineers, of Worcester, is calling an extraordinary meeting on April 25 to consider resolutions for approving a conditional agreement for the purchase of the entire share capital, £200,000, of the Morton Machine Company, Limited, Wishaw, Scotland, for £233,500. It is proposed to effect the purchase by the issue of 400,000 ordinary 5s. shares, at 10s. a share, and a cash payment of £33,500. Resolutions will also be considered at the meeting for the creation of an additional 200,000 4½ per cent. cumulative redeemable preference £1 shares and for the creation of an additional 300,000 ordinary 5s. shares. If approval is granted, the company's capital would amount to £975,000.



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Company News

(Figures for previous year in brackets.)

HUMPHREYS—Dividend of 15% (same).

JOSEPH LUCAS—Interim dividend of 5% (same).

BLAW KNOX—Final dividend of 20%, making 30% (same).

BERALT TIN & WOLFRAM—Interim dividend of 12½% (20%).

JOHN SUMMERS & SONS—Final dividend of 6%, making 8½% (same).

TIPPER INDUSTRIES—Final dividend of 17½%, making 25% (same).

DUNSWART IRON & STEEL WORKS—Interim dividend of 6% (same).

JAMES H. LAMONT & COMPANY—Final dividend of 20%, making 25% (same).

SUPERHEATER COMPANY—Final dividend of 25%, making 45% (same).

BRITISH ELECTRIC RESISTANCE COMPANY—Interim dividend of 5% (same).

CROSSLEY BROS.—Interim dividend of 4% on the deferred ordinary shares (same).

CLAYTON DEWANDRE COMPANY—Final dividend of 8%, making 12% (same).

MANGANESE BRONZE & BRASS COMPANY—Final dividend of 20%, making 30% (same).

QUIRK, BARTON & COMPANY—Final dividend of 6% and bonus of 4%, making 12½% (same).

BRITISH UNITED SHOE MACHINERY COMPANY—Final dividend of 7½%, making 13½%, tax free (same).

UNITED FLEXIBLE METALLIC TUBING COMPANY—Final dividend of 11% (9%), and bonus of 5%, making 20% (same).

CONTROL SYSTEMS—Final dividend of 12½% and bonus of 5% for the nine months to December 31, 1948, making 25% (same).

C. & W. WALKER—Dividend of 13½% (same), cash bonus of 1½% (same), and jubilee bonus of 1½% (nil), not subject to tax, from investment realisations.

GENERAL ENGINEERING COMPANY (RADCLIFFE)—Profit for the year to November 30, 1948, before tax, £69,353 (£26.365); to taxation, £41,750 (£16,500); general reserve, £2,000 (same); dividend of 20% (same); forward, £32,626 (£14,173).

A.C.E. MACHINERY—Profit for the year to September 30, 1948, £59,283 (£20,953); to depreciation, £2,820 (£2,491); directors' emoluments, £3,400 (£2,366); audit fees, £417 (£413); net profit, £52,646 (£15,683); to taxation, £28,000 (£8,817); dividend of 20% (15%), £6,600 (£4,950); forward, £30,703 (£12,657).

CROFTS ENGINEERS (HOLDINGS)—Group profits for 1948, £458,745; to tax, £245,767; after allowing for dividends, writing £5,000 off goodwill, and deducting £434,975 profits of subsidiaries prior to acquisition and retained by them, there remains £17,265 to go forward (£313,291 brought in). In the prospectus published last December profits for 1947 were given as £333,083.

NATIONAL BOILER & GENERAL INSURANCE COMPANY—Profit and loss account for 1948 shows transfer from revenue account, £166,093 (£125,416); interest, £28,686 (£27,956); sales department profit, £17,773 (£14,748); to pension funds, etc., £61,153 (£56,333); tax, £73,728 (£64,436); reserve, £20,000 (£30,000); additional reserve, £14,666 (nil); dividend of 64s. per share (62s.); forward, £121,236 (£104,631). Net premiums, etc., £887,788 (£765,062); claims, etc., £696,091 (£632,363).

GENERAL REFRACTORIES—Group trading profit for 1948, £487,337 (adjusted £330,681); other income, £738 (£936); to interest, £1,508 (£2,374); depreciation, £94,440 (£77,711); income tax, £164,810 (£104,965); profits tax, £53,500 (£35,675); foreign tax, £6,704 (nil); profit, £167,113 (£110,951); tax provision no longer required, £15,911; parent company's balance, £133,970 (£83,313); to general reserve, £75,000 (£50,000); dividend of 12½% (10%), £44,687 (£35,750); forward, £81,175 (£66,892).

RICHARD LLOYD—Trading profit for 1948, £86,048; interest, £402; net profit, after taxation, etc., £37,520 (£22,220); provision for taxation not required, £8,000 (nil); transfer from special reserve, nil (£3,125); dividend of 1s. per share (1s. and further 2½d. per share, tax free, from special reserve), £8,250 (£11,375); general reserve, £10,000 (nil); research and development reserve, £15,000 (£10,000); special reserve, £402 (£286); forward, £17,706 (£17,427, less additional directors' fees).

PLATERS & STAMPERS (made public in January, 1948)—Consolidated trading profit for 1948, £248,058 (£191,494); other income, £3,199 (£2,306); to directors' emoluments, £14,194 (£13,550); audit, £50 (£1,032); depreciation, £20,859 (£18,761); tax, £108,806 (£83,690); combined net profit, £106,848 (£76,767); to undistributed profit of subsidiary, £1,740 (£2,054); net profit of Platers & Stampers, £105,108 (£74,713); brought in, £229,366 (£149,943); tax over-provided, £10,503 (£4,709); dividend of 35%, £50,050 (nil); forward, £294,926.

WILLIAM GRAY & COMPANY—Trading profit for 1948, £422,455 (£308,237); interest, dividends, etc., £20,534 (£3,377); taxation on account of previous years, nil (£69,748); to depreciation, £67,289 (£53,002); directors' fees, £1,750 (same); other emoluments, £20,706; auditors, £395; taxation, £201,693 (£157,177); net balance, £151,256 (£159,433); to reserve, £10,000 (£15,000); repairs, £12,000 (£50,000); capital losses—Tees and Wear yards—amount written off, £100,000 (£75,107); dividend of 3½% (2½%), £23,875 (£20,625); forward, £10,191 (£9,810).

P. & W. MACLELLAN—Group trading profit for 1948, £122,565; other income, £5,064; to depreciation, £15,042; debenture interest, £6,561; tax—less £12,034 adjustments—£41,910; subsidiaries' reserves—capital £340, revenue £5,250—outside holders in subsidiaries, £5,536; undistributed profits of subsidiaries applicable to holding company, £5,675; profit of holding company, £47,315; net adjustment of previous years, £37,220; brought in, £14,412; available, £98,947; to general reserve, £10,000; stocks, £30,000; plant replacement, £15,000; pensions, £8,000; dividend of 7%, £13.157; forward, £22,780.

INTERNATIONAL COMBUSTION—Consolidated trading profit to September 30, 1948, £435,467 (£225,189); other income, £28.776 (£44,928); to taxation, £280.118 (£180,339); group net profit, £184.125 (£89,778); to outside interest, £409 (£122); profits retained in subsidiaries, £2.57? (nil); net profit dealt with in accounts of International Combustion, £181,137 (£89,656); brought in, £124,958 (£112,789); additional profit on contracts executed in previous years, net, £116,878 (nil); dividend of 37½% (same); general reserve, £250.000 (nil); forward, International Combustion £95,486 (£124,952), subsidiaries £3,454 (nil).

WATFORD ELECTRIC & MANUFACTURING COMPANY—Trading profit for 1948, after all working expenses, directors' commission, employees' fund and superannuation scheme, £39,678 (£32,348); interest, £103 (£45); fees, £17 (£23); to depreciation, £1,608 (£1,167); leaving £38.190 (£31,249); brought in, £49,623 (£40,694); tax provision no longer required, £2,007 (£3,256); provision for contracts not now required, £1,746 (£2,638); investment sale, £262 (nil); to tax, £20,310 (£18,684); buildings reserve, nil (£2,000); special depreciation, £863 (£600); preference dividend, £2,178 (£1,980); final ordinary dividend of 10%, making 15% (same), and bonus of 5% (nil); forward, £50,557 (£49,623).

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

CORK, April 23—Supply of class B spun-iron and asbestos cement water mains, and cast-iron specials, for the County Council. Mr. E. Callanan, secretary, Council Offices, District Hospital, Mallow, Co. Cork.

GLANFORD BRIGG—Contract No. 2:—Supplying and laying about 6 miles of 4-in. and 3-in. dia. spun-iron mains. Contract No. 3:—Supplying and laying about 16 miles of 6-in., 4-in. and 3-in. dia. spun-iron mains, for the Rural District Council. Mr. J. H. Haiste, consulting engineer, 4, Queen Square, Woodhouse Lane, Leeds, 2. (Fee £3 3s., returnable.)

INDIA—Textile machinery, for the Sri Krishnarajendra Silver Jubilee Technological Institute. (Reference: C.R.E. (I.B.) 8006/49.)

KETTERING, April 29—Supply and laying of about 2,000 yds. of 4-in. dia. spun-iron water main, for the Rural District Council. Pick, Everard, Keay & Gimson, engineers, 6, Millstone Lane, Leicester. (Deposit, £1 1s.)

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Grading mainly between 30 and 85 mesh B.S.S. and practically free from fines below 85.

Uniform grading gives closer control of mixtures.

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Negligible clay content.

Superior to natural sand for special purposes e.g. synthetic moulding mixtures, cement moulding process, etc.

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Practically all passing 60 mesh B.S.S. with main grain size between 72 and 150.

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Raw Material Markets

Iron and Steel

Scanty supplies of raw materials still retard that rapid expansion of pig-iron production which is so urgently needed. Consumers have no option concerning the increased prices, but they would pay with better grace if deliveries were adequate for current requirements. There is a sustained call for supplies of both No. 3 pig-iron and special refined grades from foundries, the majority of which are maintaining a steady rate of operations. A reduction of output of high-phosphorus pig-iron must be expected shortly, however, in view of two blast furnaces in the Derbyshire area being put out of commission for relining. Supplies of low- and medium-phosphorus pig-iron for the general engineering and jobbing foundries are steady and supplies of hematite are showing some improvement.

Demand from re-rollers continues at a high level and they are anxious to acquire all the steel available. Their requirements are far more than can be met by home producers, but, fortunately, good deliveries are arriving from the Continent. It is also reported that the British Iron & Steel Corporation, Limited, is negotiating for even larger supplies of billets from abroad. The mills have heavy commitments and take up readily any defective material which is offered.

The demand from the collieries for props, roofing bars, arches, etc., continues to be strong and makers are well booked for several months ahead. Wire, strip and rail mills are working to capacity on orders for both home and export account, while sheetmakers are so heavily booked that it is now more than ever difficult to get new business placed.

Non-ferrous Metals

Sentiment has weakened further as a result of more price reductions in the United States, where zinc has dropped another cent to 15 cents per lb. The reduction in lead and zinc made by the Ministry of Supply to meet the lower quotations ruling in the U.S. were given effect at the beginning of last week, but they proved to be rather disappointing to the trade. This is because both metals, even at the reduced levels, stand well above the parity of the American prices and it is to be hoped that the authorities will make a point of bringing the two market levels into alignment. It is now quite evident that there is a real break-up in the American base-metal price structure and confidence is badly shaken. So far, no change has been made in the British price of copper, although there is an inclination on the part of the custom smelters in the U.S. to shade the quotation. The position is, in fact, somewhat confused, for reports from New York have recently given the export price as 23.37 to 23.62 cents per lb., f.a.s. It is, however, understood that little or no business is passing at the present time so far as overseas buyers are concerned. Buying for the stockpile is still in abeyance, although deliveries of metal to this reserve are continuing against purchases made by the Government some time ago.

Scrap prices in this country show little change, but at the exceptionally low level reached for secondary copper there is not a great deal being offered. In fact, it would be difficult to secure a regular flow of high-grade copper-wire scrap at the lowest levels now ruling. Rather a different position obtains in brass, for the Government is once again disposing of Q.F. brass shell cases and it is reported that this flow of high-grade metal on a generous scale is likely to continue for some months. At what level these sales will be made it is hard to state, but it can be said that the material is going to be slow of sale, for consumer demand is nothing like as good as it was. The merchants, too, are going to be chary of taking much metal into stock, for it will be easy to lose money on the deal. Brass swarf is now down to about £40 per ton.

Rates of Plant Hire

The main changes in the Control of Rates of Hire of Plant Order, 1949 (S.I. 1949, No. 567) (H.M. Stationery Office, price 2d.), which has been made by the Minister of Works and which replaces the previous Order governing rates of hire of plant, are that the maximum rates of hire for concrete mixers are amended; that the 44-hr. week and the 8-hr. day are substituted for the 48-hr. week and the 8½- and 5½-hr. day for rollers, with amended rates calculated on a "per hour" basis; and that separate maximum rates of hire are adopted for scrapers.

The new Order, which came into effect on April 1, like the old, lays down that no person shall let or take on hire, or agree or offer or invite any offer to let or take on hire any of the specified items of plant, etc., except at rates not exceeding those mentioned in the schedule to the Order. Control of second-hand plant prices was removed last year.

Scientific Liaison Officer in France

In agreement with the Foreign Office, the Department of Scientific and Industrial Research has appointed Mr. A. H. Waterfield, a principal scientific officer, formerly of the Ministry of Supply, for scientific liaison duties in France, with the rank of attaché at H.M. Embassy in Paris. Mr. Waterfield, who is a metallurgist with special experience in the light-alloy field, was formerly on the headquarters staff of the Ministry of Aircraft Production, later the Ministry of Supply, and during the last year has been secretary of the Inter-Service Metallurgical Research Council. In 1946-47 he was attached to the United Kingdom scientific mission in Washington for metallurgical liaison duties.

As scientific attaché in Paris his responsibilities will include helping U.K. departments on various matters of fundamental and applied science and technology in France, especially in the fields of interest to the D.S.I.R. and the industrial research associations.